Superfund Program

Proposed Plan – May 2015
Allied Paper/Portage Creek/Kalamazoo River – Operable Unit 5, Area 1
Kalamazoo, Michigan

1. INTRODUCTION

The purpose of this Proposed Plan is to: (1) provide background information regarding the Allied Paper/Portage Creek/Kalamazoo River Superfund site; (2) describe the various cleanup alternatives considered for cleaning up Area 1 of Operable Unit 5 (OU5) of the Kalamazoo River; (3) identify U.S. Environmental Protection Agency's (EPA's) preferred cleanup alternative and explain the reasons for that preference; and (4) solicit public review of and comment on the various alternatives evaluated.

This document is issued by EPA, the lead agency for site activities. The Michigan Department of Environmental Quality (MDEQ) is the support agency. EPA, in consultation with MDEQ, will select a final remedy for Area 1 of OU5 after considering all comments submitted during a 30-day public comment period. The public comment period runs from May 4, 2015 through June 3, 2015.

EPA encourages the public to review and comment on this Proposed Plan. EPA also encourages community members to attend and participate in an open house and public meeting at the Kalamazoo Nature Center Cooper's Glen Auditorium 7000 N. Westnedge Avenue Kalamazoo, MI 49009, on May 19, 2015. The public meeting will be held at 6:00 pm. EPA will accept oral comments during the public meeting and written comments at any time during the public comment period.

EPA's decision on the final remedy for Area 1 of OU5 will be announced in local newspaper notices and presented in an EPA document called a Record of Decision (ROD). EPA's final cleanup decision for Area 1 could differ from the preferred alternative in this Proposed Plan depending on information or comments EPA receives during the public comment period, so it is important for the public to comment on all of the cleanup alternatives discussed in this document.

As described in more detail later in this proposed plan, EPA is proposing Sediment Alternative S-3A and Floodplain Soil Alternative FPS-4A as the proposed measures to remediate polychlorinated biphenyl (PCB) contamination in Area 1 of OU5. Sediment Alternative S-3A would remove impacted sediment in at least five hot spot areas and the Crown Vantage side channel, and would use monitored natural recovery (MNR), institutional controls (ICs), and engineering controls (ECs) throughout Area 1. Floodplain Soil Alternative FPS-4A would excavate floodplain soil with PCB concentrations greater than 20 milligrams per kilogram (mg/kg) in contiguous areas of one-quarter acre or larger, would place clean backfill/topsoil in excavated areas, and would use ICs/ECs and long-term monitoring (LTM) in the former Plainwell Impoundment. The proposed measures to remediate the contaminated sediment and soil in Area 1 of OU5 would be protective of human health and the environment, would meet

applicable or relevant and appropriate requirements (ARARs), would be cost effective, and would be effective in the long term.

EPA is issuing this Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This Proposed Plan summarizes information that can be found in greater detail in the Supplemental Remedial Investigation (SRI) Report and the Feasibility Study (FS) Report and other documents contained in the Administrative Record file for Area 1 of OU5. EPA and MDEQ encourage the public to review these documents to gain a more comprehensive understanding of the site and the Superfund activities that have been conducted at the site to date. Supporting documents for the site are available at any of the following locations:

Kalamazoo Public Library
315 S. Rose
Kalamazoo, MI 49007
(269) 342-9837
Call for Hours

EPA Region 5 Records Center
77 W. Jackson Blvd. (SRC-7J)
Chicago, IL 60604
(312) 353-1063
Mon-Fri: 8 am to 4 pm - *Call for appointment*

Charles Ransom Library
180 South Sherwood
Plainwell, MI 49080

Allegan Public Library
331 Hubbard Street
Allegan, MI 49010

Otsego District Library
219 South Farmer Street
Otsego, MI 49078

Waldo Library
Western Michigan University
1903 West Michigan Avenue
Kalamazoo, MI 49008

Saugatuck-Douglas Library
10 Mixer Street
Douglas, MI 49406

2. SITE BACKGROUND

The Allied Paper/Portage Creek/Kalamazoo River Superfund site was listed on the National Priorities List in August 1990 and consists of four disposal areas, five former paper mill properties, approximately 77 miles of the Kalamazoo River from the dam at Morrow Lake to Lake Michigan, and a 3-mile stretch of Portage Creek. The site is located in both Allegan and Kalamazoo Counties of southwest Michigan (see Figure 1).

EPA often divides complex cleanup sites into smaller, more manageable sections called operable units or OUs. The entire site is composed of six different OUs:

- OU1 – Allied Paper, Inc./Bryant Mill Pond;
- OU2 – Willow Boulevard/A-Site Landfill;
- OU3 – King Highway Landfill;
- OU4 – 12th Street Landfill;
- OU5 – 77 miles of the Kalamazoo River and a 3-mile stretch of Portage Creek; and
- OU7 – former Plainwell Paper Mill Property.

Site History

This section of the Proposed Plan provides the history of the site and briefly discusses the various removal action activities and associated investigations that have been conducted in Area 1 of OU5.

The site is primarily contaminated with PCBs that were found in the waste stream at paper mills, although other industrial operations also used PCBs along the Kalamazoo River. The former paper mills recycled and/or de-inked and repulped carbonless copy waste paper which, between the 1950s and 1970s, contained PCBs as an ink carrier. For the most part, the mill operators discharged wastewater directly into the Kalamazoo River and left dewatered wastes, commonly referred to as residuals, in on-site dewatering lagoons or disposed of the PCB-contaminated residuals in other land or wetland areas.

The Michigan Department of Natural Resources first became concerned about the presence of PCBs in the Kalamazoo River in 1971, after routine surface water and biota sampling at the mouth of the river indicated that PCBs were discharging to Lake Michigan via the Kalamazoo River and that the PCBs were widely bioavailable for uptake by fish and aquatic organisms. The primary risks associated with the site are from human consumption of PCB-contaminated fish which have become contaminated due to erosion and runoff of PCB-contaminated soil and sediment in Portage Creek and the Kalamazoo River.

Six former hydroelectric dams are located on the river within the site boundaries. In the 1970s, the State of Michigan partially dismantled three dams (Plainwell, Otsego, and Trowbridge). This dropped the river water level and the contaminated sediment that was once under water became exposed. Lowering of the dams also increased bank erosion. EPA and MDEQ currently estimate that there are approximately 113,000 pounds of PCBs in the river sediment and floodplain soil.

OU5 encompasses 77 miles of the Kalamazoo River from Morrow Dam east of Kalamazoo to the river mouth at Lake Michigan, plus a 3-mile stretch of Portage Creek in Kalamazoo. EPA divided OU5 into seven different areas (see Figure 2). This Proposed Plan focuses on Area 1.

Area 1 is the most upstream segment of the site and includes the 22-mile reach of the Kalamazoo River from Morrow Dam to the former Plainwell Dam as well as the 3-mile stretch of Portage Creek from Alcott Street to its confluence with the Kalamazoo River (see Figure 3). Area 1 flows through the communities of Comstock, Kalamazoo, Parchment, and Plainwell. Several former paper mills and disposal areas associated with the site are located along this reach of the river and creek. To date, remediation work along the Kalamazoo River and the adjacent OUs has included multiple PCB source control and elimination activities in Area 1. These activities have addressed the most significant known sources of PCBs and help support reductions in PCB levels in fish tissue. Sediments, fish, and floodplain soils are the media of concern in Area 1.

Area 1 has been divided into separate, distinct river sections based on variations in the physical and chemical characteristics of the sediment within this stretch of OU5. The Area 1 segments are

defined by landmarks and river mile (RM) measurements from the mouth of the Kalamazoo River at Lake Michigan, as listed below and shown on Figure 4:

- Section 1: Morrow Dam (RM76.50) to King Highway (RM73.10)
- Section 2: King Highway (RM73.10) to Portage Creek (RM71.65)
- Section 3: Portage Creek (RM71.65) to Mosel Avenue (RM70.00)
- Section 4: Mosel Avenue (RM70.00) to D Avenue (RM65.10)
- Section 5: D Avenue (RM65.10) to Railroad Bridge (RM59.40)
- Section 6: Railroad Bridge (RM59.40) to Plainwell No. 2 Dam (RM58.20)
- Section 7: Plainwell No. 2 Dam (RM58.20) to Main Street, Plainwell (RM56.65)
- Section 8: Main Street, Plainwell (RM56.65) to former Plainwell Dam (RM54.75)
- Mill Race: Plainwell No.2 Dam (RM58.20) to confluence near Main Street (RM56.60)

Past Site Investigations in Area 1

Superfund investigations of the site began in 1993, with the State of Michigan serving as the lead agency. EPA became the lead agency in 2002. Over the years, various parties – including potentially responsible parties (PRPs), EPA, and the State – collected an extensive body of data from a variety of environmental media. At OU5 (Areas 1 through 7), more than 15,000 samples had been collected and analyzed prior to the start of the SRI work in 2007. The samples were analyzed for various constituents including PCBs, metals, polycyclic aromatic hydrocarbons, and pesticides.

Sediment data for Area 1 have been collected under various sampling programs, starting with the original remedial investigation (RI) work in 1993/1994. Data from the original RI were used to develop an understanding of spatial and historical PCB trends in sediment in Area 1. These data were supplemented in 2000 by additional sediment sampling. Bank soil and sediment sampling was conducted in 2003 and 2005-2006, respectively, in the former Plainwell Impoundment area. From 2007 through 2009, field investigations were performed in Area 1 as part of the SRI and added more than 4,100 PCB data points for Area 1 sediment and soil. The primary intent of the SRI work was to address localized data gaps.

Past Cleanup Activities in Area 1

In keeping with EPA's principles for managing contaminated sediment sites, EPA has conducted or overseen cleanup activities within or along Area 1 of OU5 since 1998, with the goal of controlling sources of PCBs to the river. These activities have included time-critical removal actions (TCRAs) in and along Portage Creek and the Kalamazoo River as well as interim and final remedial actions at former paper mill properties and disposal areas (i.e., at other OUs). Below are brief summaries of the removal actions that have been conducted in Area 1 of OU5. More detailed information is available in various documents contained in the Administrative Record file.

Bryant Mill Pond TCRA

An important effort in reducing PCB concentrations in the creek and river was the Bryant Mill Pond TCRA. The former Bryant Mill Pond, located within OU1, is a 29-acre area on Portage Creek that was the furthest upstream source of PCBs to OU5, with PCB concentrations prior to the removal action as high as 1,000 mg/kg. EPA conducted a TCRA in 1998-1999 and removed 150,000 cubic yards (cy) of sediment and floodplain soil. Excavated materials were placed in former dewatering lagoons at OU1 and capped. The lagoons are on higher ground and are protected from stream flows by a stabilized dike.

Post-removal PCB concentrations in sediment excavation areas were below 0.46 mg/kg, and 92 percent of post-removal samples overall were below the PCB performance standard goal of 1 mg/kg. PCB concentrations in Portage Creek surface water in the former Bryant Mill Pond area were reduced by two orders of magnitude following the TCRA, and PCB concentrations in fish tissue were reduced by one order of magnitude; these decreases in fish tissue concentrations have been maintained in carp and whole body white suckers since the TCRA.

Plainwell Impoundment TCRA

Under a 2007 Administrative Order on Consent (AOC), Georgia Pacific (GP) and Millennium Holdings, LLC (Millennium), two PRPs, conducted a TCRA at the area within Area 1 of OU5 known as the former Plainwell Impoundment. The 2007-2009 TCRA removed approximately 126,700 cy of sediment and soil and addressed roughly 7,625 linear feet of riverbank, and the contaminated materials were disposed at off-site commercial landfills. The PRPs completed the required post-removal monitoring and maintenance for the TCRA in 2013.

The TCRA design incorporated removal of sediment and soil, with bank stabilization to prevent erosion and downstream migration of PCBs after removal of the dam. The PRPs chose to remove the dam as part of this TCRA based on design restoration considerations. Near-shore sediment was generally excavated 40 feet outward from the river bank, down to the native gravel riverbed, with a sediment performance standard goal of 1 mg/kg PCBs. Sediments in the center of the river that could not be safely reached by the excavation equipment and that had PCB concentrations less than 50 mg/kg were left in place. This "prism" of mid-channel sediment was expected to gradually erode over time. The TCRA also excavated a 30-foot-wide area of soils adjacent to the river in areas where PCB concentrations exceeded 5 mg/kg (or 4 mg/kg adjacent to residential areas). Near the Plainwell Dam the TCRA excavated a 150-foot-wide area of soils adjacent to the river to keep PCBs from eroding into the river. Other known floodplain areas with PCB concentrations exceeding 50 mg/kg also were excavated. As a result of the removal of the Plainwell Dam, the Kalamazoo River now flows freely through that area, as it did prior to construction of the dam.

Post-removal surface sediment sampling results ranged from non-detect to 48 mg/kg, with an average PCB concentration of 1.7 mg/kg. For floodplain soils, post-removal sampling results showed that the surface-weighted average concentration (SWAC) is 6.6 mg/kg, compared to the pre-TCRA soil SWAC of 17 mg/kg. Post-removal sampling of the mid-channel prism sediment, which was not excavated, found average PCB concentrations of less than 0.6 mg/kg. Bathymetric

monitoring of the prism sediment was performed twice per year to assess prism erosion (as discussed above). The AOC goal of an 80 percent decrease in volume of sediments in the mid-channel prism was achieved in 2010, seventeen months after the dam was removed. Between 2006 and 2011, adult fish tissue concentrations declined between approximately 2% and 10%.

As part of the Plainwell Impoundment TCRA, five quarterly[1] groundwater sampling events were conducted in a network of 15 monitoring wells. PCBs were not detected in groundwater.[2]

Plainwell No. 2 Dam Area TCRA

Under a 2009 AOC, GP conducted a TCRA in the portion of Area 1 of OU5 known as the Plainwell No. 2 Dam area. The TCRA targeted riverbank soil, sediment in a portion of a historical oxbow channel, and soil in a floodplain area next to the oxbow. The 2009-2010 TCRA removed approximately 15,700 cy of material and addressed roughly 10,000 linear feet of riverbank, and the contaminated materials were disposed in off-site commercial landfills.

Similar to the earlier Plainwell Impoundment TCRA, a 30-foot-wide area of soils adjacent to the river was excavated in areas where PCB concentrations exceeded 5 mg/kg (or 4 mg/kg adjacent to residential areas). The sediment performance standard goal was the same as for the Plainwell Impoundment TCRA (1 mg/kg).

The post-removal sediment SWAC in the oxbow area was 6.6 mg/kg, compared to the pre-TCRA sediment SWAC of 18 mg/kg. For floodplain soils, the post-removal SWAC is 2.4 mg/kg, compared to the pre-TCRA soil SWAC of 3.2 mg/kg. Between 2009 and 2011, wet weight fish tissue concentrations decreased by approximately 50% for carp and young-of-year smallmouth bass and approximately 30% for adult smallmouth bass.

Portage Creek TCRA

From 2011-2013, EPA conducted a TCRA in a portion of Portage Creek, between Reed Street and the creek's confluence with the Kalamazoo River, where sediment concentrations were as high as 590 mg/kg and floodplain soil concentrations were as high as 72 mg/kg. The TCRA removed a total of 23,727 cy of soil and sediment from targeted, high-priority areas of Portage Creek and its floodplains. Areas with PCB concentrations greater than 10 mg/kg were targeted for removal. Similar to prior TCRAs in Area 1, the Portage Creek TCRA used a PCB performance standard goal of 1 mg/kg for sediments.

The majority of areas remediated during the Portage Creek TCRA were backfilled with two to six feet of clean fill material to return Portage Creek to its original grade. Post-removal monitoring to verify the effectiveness of the TCRA includes surface water monitoring, soil and sediment confirmation monitoring, fish tissue monitoring, and monitoring/maintenance of

[1] Quarterly sampling means sampling was conducted four times per year, roughly every 3 months.

[2] Based on this information, in conjunction with groundwater information from other site OUs and knowledge of the nature of the PCB contamination at the site, EPA has concluded that groundwater is not a medium of concern at Area 1 of OU5.

erosion controls. EPA's estimated post-removal PCB SWAC in Portage Creek sediment is 1.88 mg/kg, compared to an estimated pre-TCRA SWAC of 6.1 mg/kg.

Enforcement Activities

In February 2007, GP and Millennium entered into two separate AOCs with EPA: one to conduct a series of supplemental remedial investigations and feasibility studies (SRIs/FSs) at OU5 and a second to conduct a TCRA at the former Plainwell Impoundment TCRA (discussed above). Following its bankruptcy, Millennium stopped participating in the SRI/FS work. In June 2009, GP entered into an AOC to conduct a TCRA at the Plainwell No. 2 Dam area (discussed above).

EPA conducted the 2011-2013 Portage Creek TCRA because Millennium (a PRP for that section of Portage Creek) was bankrupt and no other PRPs agreed to conduct the work. (GP is not considered a PRP for the Portage Creek section of OU5.) EPA intends to seek recovery of its costs for the TCRA.

In addition to enforcement activities related to OU5, EPA and/or MDEQ have engaged PRPs to conduct work at other site OUs, as follows:

- Millennium put in place interim remedial measures at the Allied Paper property (OU1) that effectively controlled the OU1 landfill wastes from entering Portage Creek.
- Millennium conducted RI/FS work at the Allied Paper property (OU1) until its bankruptcy; EPA subsequently took over completion of the FS.
- GP conducted the remedial design (RD) and remedial action (RA) work at the Willow Boulevard/A-Site Landfill (OU2) and the King Highway Landfill (OU3).
- Another PRP, Weyerhaeuser Company, conducted the RD/RA work at the 12th Street Landfill (OU4), and is conducting the RI/FS work (and will conduct the RD/RA work) at the former Plainwell Mill (OU7).

<u>Area 1 SRI/FS</u>

As noted above, GP conducted the SRI/FS work for Area 1 under a 2007 AOC. In accordance with the 2007 SRI/FS AOC, GP submitted many reports that it then used to support the development and evaluation of remedial alternatives for sediment and floodplain soil in the FS. The major reports are listed below and included in the Administrative Record file for Area 1 of OU5.

- Area 1 Supplemental Remedial Investigation/Feasibility Study Work Plan
- Multi-Area FS Documents – To guide the Area 1 FS and provide consistency and efficiency across all seven areas of OU5, four Multi-Area FS Planning Documents were prepared as the first step in developing the FS reports.
- Area 1 SRI Report
- Area 1 Alternatives Screening Technical Memorandum
- Area 1 FS Report

EPA conditionally approved the Area 1 SRI Report on June 28, 2012, and gave final approval of the report on August 21, 2012. EPA approved the Area 1 FS Report on November 4, 2014.

Public Participation Activities

Since 2007, EPA has conducted two public meetings per year regarding cleanup activities within Area 1 of OU5. In addition, EPA has distributed fact sheets for all of the public meetings. EPA also conducted site tours for interested stakeholders during the Plainwell Impoundment, Plainwell 2, and Portage Creek TCRAs. Most recently, on December 11, 2014, EPA held a public meeting regarding the Area 1 FS Report. During the meeting, EPA presented all relevant information to the public and answered questions about the remedial alternatives.

3. SITE CHARACTERISTICS

This section of the Proposed Plan summarizes the physical characteristics and the nature and extent of contamination in Area 1 of OU5. The significant findings and conclusions from the site characterization activities completed during the SRI are summarized below. Additional details are available in the Area 1 SRI Report.

Physical Characteristics

Most of Area 1 is a free-flowing river with relatively rapid flow velocity. Free-flowing conditions are present with the exception of low-head former diversion structures (Plainwell No. 2 Dam) upstream of the town of Plainwell. The part of the river that flows through downtown Kalamazoo generally has lower flow velocities so historically accumulated thicker deposits of sediment in some areas.

Land use along the river and creek in Area 1 varies, with industrial, commercial, municipal, recreational, and residential areas near the population centers of Comstock, Kalamazoo, Parchment, and Plainwell. Between the population centers, land use is dominated by large areas of state-owned forested land and privately-owned forested and agricultural properties. These are interspersed with residential and recreational parcels.

The river bottom is predominantly sand and gravel with some fine-grained sediment. Fine-grained sediment occurs in areas along the channel margins and in side channels. The average depth of water in the Kalamazoo River ranges from 2.4 to 6.2 feet, and in Portage Creek ranges from 0.8 foot to 1.5 feet.

Based on groundwater monitoring conducted as part of the Plainwell Impoundment TCRA, in conjunction with groundwater monitoring data from other site OUs and knowledge of the nature of the PCB contamination at the site, EPA has concluded that groundwater is not a medium of concern at Area 1 of OU5.

Nature and Extent of Contamination

This section summarizes the nature and extent of contamination in the sediment and floodplain soil within Area 1 of OU5. All PCB concentrations are reported as total Aroclors (total PCBs).

Sediment

Sediment Sampling Summary

As part of the Phase I SRI, 128 locations along 16 transects were probed between Morrow Dam and Main Street, Plainwell. From these transects, 183 sediment samples from 44 sediment cores were analyzed for PCBs, and concentrations ranged from non-detect (ND) to 210 mg/kg. Additional surface sediment samples were later collected from transect locations previously sampled during 1993/1994 and 2000. During this sampling event, 52 surface sediment samples were collected between Morrow Dam and Main Street, Plainwell, and analyzed for PCBs, and concentrations ranged from ND to 13 mg/kg.

Additional SRI sampling was also conducted in the Plainwell No. 2 dam area. From this study area, 267 sediment samples from 60 sediment core locations were analyzed for PCBs, with concentrations ranging from ND to 100 mg/kg.

An Area 1 side channel survey was performed to identify and evaluate potential sediment/PCB depositional areas that could exist in side channels adjacent to the Kalamazoo River. A total of 34 sediment samples from ten sediment core locations from selected side channel and oxbow areas were analyzed for PCBs, with concentrations ranging from ND to 6.1 mg/kg.

The stretch of the river between Crown Vantage landfill and the Plainwell No. 2 dam was resampled to evaluate areas where PCBs were observed in samples collected in 2000, and to characterize the size and orientation of potential sediment deposits in these areas. A total of 48 sediment samples from 11 core locations were analyzed for PCBs, and concentrations ranged from ND to 21 mg/kg.

Forty-two sediment cores were collected from six hot spot assessment areas (i.e., locations where transect samples indicated PCB concentrations of 50 mg/kg or greater), resulting in 234 sediment samples. The samples were analyzed for PCBs, total organic carbon, solids, and grain size. PCB concentrations ranged from ND to 310 mg/kg.

Distribution of PCBs in Sediment

Most PCBs currently in sediment are associated with lower-energy depositional areas of the river. Most of the river channel in Area 1 is in a condition of dynamic equilibrium (except for the former Plainwell Impoundment following the 2007-2009 TCRA). Dynamic equilibrium defines a condition where sediment settles out of the water column during receding flows but is susceptible to movement during increasing flows. The river in the former Plainwell Impoundment is a non-depositional area following removal of the Plainwell Dam.

PCBs are broadly distributed over the 22-mile reach of Area 1, mostly in pockets of fine-grained material. PCB concentrations greater than 50 mg/kg in sediment were identified as hot spot areas during SRI sampling events. The areas of these hot spots range from approximately 0.025 acre to 1.4 acres. Concentrated deposits of PCBs remain in sediments near the city of Kalamazoo and in a side channel next to the Crown Vantage landfill area.

Surface-Weighted Average Concentration

A SWAC is a method of spatially calculating the mean (average) concentration of a constituent in the sediment surface. Samples are collected throughout the area of concern, representative subareas are generated for each sample location, and a subarea-weighted average concentration is calculated to produce the SWAC. The subareas may be generated using several different methods such as grids or stream tubes. More details about the SWAC calculation methods are provided in the Area 1 SRI and FS Reports in the Administrative Record file.

Table 1 shows the SWACs that were calculated for Area 1, including Sections 1 through 8 and the Plainwell Mill Race. Confidence limits were developed for the SWAC calculations to confirm that the SWAC estimates represent conservative values for each river section. (A separate SWAC was calculated for the Crown Vantage side channel, as discussed below.) SWAC values were calculated using data from the 0-6" sediment interval. (Note: although technically not SWACs, area-weighted average concentrations for other, non-surface depth intervals also were calculated and are shown in Table 1. This data for other sediment depth intervals will be discussed later in this Proposed Plan.)

The 0-6" SWAC values in Table 1 indicate that river Section 3, which has a relatively high SWAC compared to the surrounding sections, should be the focus of additional evaluation to identify appropriate remedial alternatives. Although the SWACs for Sections 2 and 4 are relatively low, with SWAC concentrations less than 1 mg/kg, sample results identified PCB hot spots in these two sections. Therefore, remedial alternatives for sediment hot spot areas in river Sections 2 and 4 also were developed. The area spanning river Section 3 and portions of river Sections 2 and 4 is called the Remedial Reach and is illustrated in Figure 5.

Additional hot spots are not expected outside the remedial reach due to the low PCB concentrations observed outside of this area. As shown in Table 1, the SWACs for all other sections and intervals were less than 1 mg/kg with the exception of Section 8. The listed SWAC for Section 8 includes some sediment concentrations measured prior to the Plainwell Impoundment TCRA, so is not representative of present-day PCB concentrations in that section, which are expected to be much lower following the TCRA. Additional sampling is needed in Section 8 to confirm current conditions in that part of the river.

A separate SWAC was calculated for the Crown Vantage side channel, which is located in Section 4 approximately 1.5 miles downstream of the Remedial Reach. Based on the calculated SWAC of 8.2 mg/kg, sediment remedial alternatives also were developed for the Crown Vantage side channel.

As noted earlier, EPA completed the TCRA activities in Portage Creek in 2013. The post-TCRA sediment SWAC in Portage Creek is estimated to be 1.8 mg/kg. Portage Creek is part of Area 1 of OU5 and will be included in the Area 1 inspections and LTM program to assess restored bank conditions and to document ongoing natural recovery.

Floodplain Soil

Floodplain Soil Sampling Summary

Beginning with the original RI and continuing through the SRI, the purpose of floodplain soil investigations was to evaluate PCB deposition in formerly impounded areas, assess whether past flooding events transported PCBs to the floodplain, and characterize the nature and extent of PCB-impacted floodplain soil.

As part of the SRI, soil samples were collected from floodplain areas within Area 1. These included top-of-bank soil cores from Section 7, floodplain and adjacent soil samples near the Crown Vantage landfill in Section 4, and samples from the historically inundated area upstream of the Plainwell No. 2 Dam Area in Section 6. Most of the floodplain soil samples were collected near the dams in the former Plainwell Impoundment and the Plainwell No. 2 Dam area. Because several sampling locations subsequently were excavated as part of the TCRAs completed in these two areas, the PCB data associated with those now removed locations are no longer representative of current conditions. As a result, additional sampling will be performed as part of the RD.

Distribution of PCBs in Floodplain Soil

The floodplain soil data have been grouped into four geographic subareas of Area 1, as follows:

- Soil Area 1 is the reach from Morrow Dam to the railroad bridge at the upstream end of the Plainwell No. 2 Dam Area. Data include floodplain transect data, focused soil data within this reach, and the Crown Vantage soil data.
- Soil Area 2 is the Plainwell No. 2 Dam Area. Data include floodplain soil samples, bank samples, and other soil samples that fall within this reach.
- Soil Area 3 is the area between the Plainwell No. 2 Dam and Main Street, Plainwell. Data include top-of-bank samples from along the river and the mill race.
- Soil Area 4 is the reach from Main Street, Plainwell to the former Plainwell Dam. Data include top-of-bank and floodplain soil samples.

These soil area divisions were established based on the premise that the dams, and the different characteristics of each area, had an important influence on depositional conditions. For example, where the river flow slowed through the impoundment behind the former Plainwell Dam and in the frequently-inundated area around the two flow control structures of Plainwell No. 2 Dam area, PCB-containing sediment tended to settle out of the water column. As a result, the PCB concentrations in floodplain soil (including exposed former sediment in the former Plainwell Impoundment) in Soil Areas 2 and 4 are higher than those in the natural floodplains surrounding the free-flowing sections of the river.

Table 2 summarizes the soil data for the four Soil Areas. As shown in the table, PCB concentrations are lower in Soil Area 1, which has natural floodplains and no dams, than the other areas. Other conclusions drawn from the data include the following:

- For surface soils, the maximum PCB concentrations are lowest in Soil Areas 1 and 3, which are not directly influenced by dams, and are highest in Soil Areas 2 and 4.
- Mean surface soil PCB concentrations follow a similar pattern, with lower surface soil concentrations in Soil Areas 1 and 3 than in Soil Areas 2 and 4.
- For subsurface soils, the maximum PCB concentration was lowest in Soil Area 1 and highest in Soil Area 4.
- Mean soil PCB concentrations (any depth) were lowest in Soil Area 1 and highest in Soil Area 4.

Additionally, higher PCB concentrations and frequency of detections occur downstream of the Plainwell No. 2 Dam Area in the top-of-bank samples (Soil Area 3) and in the former Plainwell Impoundment (Soil Area 4).

In the Plainwell No. 2 Dam Area (Soil Area 2), most of the higher PCB concentrations are found within the top 0.5 foot, and the average thickness of PCB-containing soil is approximately 1.4 feet. In the former Plainwell Impoundment (Soil Area 4), PCB-containing soil is found at greater depths (approximately 1 foot to 3 feet). The average thickness of the PCB-containing layer in the former Plainwell Impoundment is estimated to be approximately 3.4 feet.

Floodplain Soil SWAC

Exposed former sediment in the floodplains of the former Plainwell Impoundment and the Plainwell No. 2 Dam Area were the primary focus of the TCRAs completed in those areas. The pre-TCRA soil PCB SWAC in the former Plainwell Impoundment and the Plainwell No. 2 Dam Area were 17 mg/kg and 3.2 mg/kg, respectively. Data representative of post-TCRA soil PCB levels indicate the current floodplain soil SWAC in the former Plainwell Impoundment is 6.6 mg/kg. In the Plainwell No. 2 Dam Area, the current post-removal SWAC is 2.4 mg/kg.

The restored riverbanks and the clean soil placed over removal areas serve as a buffer in many locations between the river and the PCBs remaining in the exposed former sediment (i.e., materials that were underwater when the dam was fully operational but are now located in the floodplain). In both TCRA locations, the riverbanks and revegetated areas are monitored and maintained to provide erosion control.

Floodplain soil data show that flooding of the Kalamazoo River has not resulted in appreciable accumulation of PCBs in the natural floodplains (i.e., areas not influenced or inundated by the historical operations of dams). Targeted sampling performed in low-lying areas indicate the average PCB concentration in the natural floodplain soil in Area 1 upstream of the railroad bridge on the upstream edge of the Plainwell No. 2 Dam Area is less than 1 mg/kg across sample depths and within the surface soil. Additional details are provided in Section 6.3 of the SRI Report.

Portage Creek floodplain soil with elevated PCB levels was addressed during the Portage Creek TCRA.

Conceptual Site Model

A conceptual site model (CSM) has been developed for Area 1 of OU5 based on site characteristics and results from the SRI investigations. The CSM tells the story of how and where the PCB contamination moved and what impacts such movement may have had upon human health and the environment.

As described in the CSM, PCBs are the primary contaminant of concern (COC). Site data shows that exposure to PCBs will drive risks at the site, and that the management of risks due to PCB exposure will also address risks associated with other non-PCB constituents. PCB levels in fish are linked to concentrations in sediment and surface water through the food chain. Risks to humans and aquatic ecological receptors are driven by the consumption of PCB-contaminated fish. Human health risk estimates show concentrations of PCBs in fish tissue result in exceedances of EPA target levels for both cancer and non-cancer risks; this will be further discussed in the "Summary of Site Risks" section of this Proposed Plan.

The primary transport mechanism is PCB uptake through the food chain via PCB-contaminated sediment that already exists in the river and that continues to enter the river by erosion of PCB-contaminated bank material. External sources of PCBs to Area 1 as well as background sources of PCBs from areas upstream of Area 1 (which have mean background sediment concentrations of 0.31 mg/kg PCB) are expected to sustain low levels of PCBs in fish tissue in the long term, even with control of known potential source areas associated with historical papermaking operations.

The media of concern in Area 1 are sediments, fish, and floodplain soils. The targeted remediation areas in Area 1 are hot spot areas in river Sections 2 and 4, the Crown Vantage side channel, and river Section 3. Remedial alternatives for sediment will address the potential for bank soil erosion and transport. Remedial alternatives for sediment will include additional post-TCRA sampling in Section 8 during the RD. As noted earlier, the calculated SWAC for Section 8 is primarily based on pre-TCRA data, and sampling during the RD will provide current representative sediment PCB concentrations. Floodplain soil in the former Plainwell Impoundment study area is targeted for remediation. In addition, an evaluation of natural floodplains outside of the impoundment areas in Area 1 for potential residential exposure to PCB concentrations is needed. Residential property sampling during RD is recommended.

Principal Threat Wastes

The principal threat concept is applied to the characterization of "source material" at a Superfund site. Source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contaminants to ground water, surface water or air, or acts as a source for direct exposure. EPA has defined principal threat wastes as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably

contained or would present a significant risk to human health or the environment should exposure occur.

EPA has not identified any principal threat wastes at OU5 of the site. The PCB-contaminated soil and sediment throughout OU5 are reworked and re-deposited materials that have been mixed with water, soil and sediment throughout Area 1. The concentrations of PCBs at OU5 are considered to be low-level threat wastes.

4. SCOPE AND ROLE OF THE ACTION

As described earlier, the Allied Paper/Portage Creek/Kalamazoo River site has been broken into a number of separate OUs. In keeping with EPA's policies regarding the management of contaminated sediment sites, EPA's approach has been to control the significant potential sources of PCBs to the river first, before addressing the contamination in the river (OU5). A number of response actions have been taken at other site OUs that effectively control releases from those OUs to OU5. The remediation of OU5 no longer depends on the sequencing of work at any of the other OUs.

OU5 of the site has been broken into seven different areas, with Area 1 being the furthest upstream and Area 7 being the furthest downstream area. While RI/FS work is being conducted concurrently in several of the OU5 areas, EPA intends to make final cleanup decisions and conduct cleanup actions in the river in one area at a time, from upstream to downstream.

The "Site Background" section of this Proposed Plan describes several removal actions that have addressed certain portions of Area 1, including the Bryant Mill Pond TCRA, the Plainwell Impoundment TCRA, the Plainwell No. 2 Dam Area TCRA, and the Portage Creek TCRA. The proposed response action in this Proposed Plan will address the remaining PCB-contaminated sediment and soil in Area 1 and is intended to be the final response action for Area 1. It does not address the other OUs at the site nor other river areas (Areas 2 through 7) within OU5.

5. SUMMARY OF SITE RISKS

This section summarizes the risks to human health and the environment that are posed by the contamination.

Contaminants of Concern

As described in the generalized CSM, PCBs are the primary COCs. The available data indicate that exposure to PCBs will drive risks at the site, and that management of risks due to PCB exposure will also address risks associated with other non-PCB constituents. This was recognized in the site-wide ecological risk assessment (ERA), which stated:

> "*PCB contamination is considered to be the primary focus of this ERA because of the current magnitude and distribution of PCBs throughout the [site]. This ERA, therefore, does not consider the additional incremental effects that may be caused by other chemical stressors…*"

During the investigation of Areas 1 and 2 of OU5, samples collected from various media in and along Portage Creek and the Kalamazoo River, including soil, sediment, surface water, and biota (fish tissue), were selectively analyzed for non-PCB constituents. Samples were analyzed for metals, volatile organic compounds, semi-volatile organic compounds, pesticides, and polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans (dioxins and furans). The results of these analyses are presented and evaluated in Appendix M of the SRI Report. Many non-PCB constituents were detected in all media, likely from multiple point and non-point sources in the industrialized portions of the watershed (and general anthropogenic deposition throughout the watershed), and may not be directly linked to the PCB releases. The Area 1 data suggest that several non-PCB constituents with an affinity for fine-grained organic particles – similar to that of PCBs – are co-located with PCBs as a result of similar transport and deposition mechanisms. Due to their low frequency of detection, low concentration, and/or ubiquitous nature, non-PCB constituents are not expected to drive risks to human health and the environment. A more thorough evaluation of the non-PCB constituents detected in Areas 1, 2, and 3 of OU5 was completed in March 2015 and concluded that PCBs are the primary COC and risk driver in Area 1.

Baseline Human Health Risk Assessment

The baseline human health risk assessment (BHHRA) for the site was completed by MDEQ's contractor (CDM) in 2003 as part of the original RI. The BHHRA evaluated potential current and future risks to people who may live or engage in recreational activities near the Kalamazoo River and its floodplains along all seven areas of OU5, including risks to subsistence and sport anglers who may consume fish caught from the Kalamazoo River. Additionally, the Michigan Department of Community Health (MDCH) prepared a Health Consultation for the site in 2002.

In 2012, GP's contractor (ARCADIS) updated the BHHRA as part of the SRI to reflect the results of additional fish tissue samples collected since the publication of the 2003 BHHRA. The updated BHHRA provided updated risk and hazard estimates for subsistence and sport anglers associated with exposures to PCBs released into the Kalamazoo River system.

In addition to fish consumption by anglers, several other potential exposure pathways were described in the 2003 BHHRA that are relevant to Area 1, as follows:

- *Consumption of turtles:* Although this pathway was evaluated qualitatively as a potential exposure pathway, the BHHRA concluded that the overall exposure and risks to receptors ingesting turtles would be less than that of anglers. The analytical data that exist for turtle tissue indicate that PCB concentrations are less than that for smallmouth bass and carp fish tissue.
- *Consumption of waterfowl*: This exposure pathway was considered in the BHHRA. However, because of data limitations with waterfowl samples, CDM did not complete a qualitative evaluation or quantify risk estimates for this exposure pathway.
- *Direct contact with river sediment (by swimmers or waders):* Direct contact exposures to river sediment during recreational activities (swimming, wading) were determined not to be important means of exposure to PCBs, based on the Health Consultation prepared by the MDCH. As a result, such exposures were not evaluated further in the BHHRA.

- *Exposure to in-stream surface water (by swimmers or waders):* Due to the relatively low ingestion rates of surface water, the low solubility of PCBs in water, and the low dermal absorption of PCBs, the BHHRA concluded that this pathway could be assumed to be without risk.
- *Exposure to air:* Inhalation of particulates and volatile emissions from exposed floodplain soil and sediment were quantitatively evaluated in the BHHRA, but inhalation of volatile emissions from surface water was not quantitatively evaluated.
- *Direct contact with floodplain soil and exposed sediment:* Residential developments exist next to the floodplains in the former Plainwell Impoundment, the Plainwell No. 2 Dam Area, and in other locations throughout Area 1. The BHHRA quantitatively evaluated direct contact pathways (dermal contact and incidental ingestion) that may be relevant to residents (the most highly-exposed receptor group) or recreational visitors.

Fish Advisory

MDCH has issued a fish advisory for parts of Portage Creek and the Kalamazoo River, extending from Morrow Lake Dam to Lake Michigan. For the river area from Morrow Lake Dam to the Allegan Dam (which is located in Area 6), and on Portage Creek downstream of Monarch Mill Pond (which is located just upstream of OU1), the advisory currently recommends that the general population not consume carp, catfish, suckers, smallmouth bass, or largemouth bass from these areas. Between Allegan Dam and Lake Michigan, the advisory recommends that the general public not consume carp, catfish or northern pike. Healthy adult males are advised to eat no more than one meal per week of all other species. For women of childbearing age and children under 15 years of age, no consumption of any species is recommended for fish caught above Allegan Dam (including Area 1).

MDCH's fish consumption advisory is only a recommendation, is not legally binding, and has limited effectiveness in protecting human anglers from Kalamazoo and Allegan Counties. A survey from 1994 showed that anglers ate on average two meals per month of various species taken from contaminated reaches of the river, including bass, catfish, panfish, bullheads, and carp. More than 10 percent of anglers ate more than one meal per week of these various species. This survey confirmed that the Kalamazoo River is an important recreational resource and may serve as an important source of food for certain human subpopulations.

BHHRA Conclusions

The likelihood of any kind of cancer resulting from exposure to carcinogens at a Superfund site is generally expressed as an upper bound incremental probability, such as a "1 in 10,000 chance" (expressed as 1×10^{-4}). In other words, for every 10,000 people exposed to the site contaminants under reasonable maximum exposure conditions, one extra cancer may occur as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risk of cancer individuals face from other causes such as smoking or too much sun. The risk of cancer from other causes has been estimated to be as high as one in three. The potential for non-cancer health effects is evaluated by comparing an exposure level over a specified time period (such as a lifetime) with a "reference dose" derived for a similar exposure period. A reference dose represents a level that is not expected to cause any harmful effect. The

ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ < 1 indicates that the dose from an individual contaminant is less than the reference dose, so non-cancer health effects are unlikely. The hazard index (HI) is generated by adding the HQs for all COCs that affect the same target organ (such as the liver). An HI < 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, non-cancer health effects from all contaminants are unlikely. An HI > 1 indicates that site-related exposures may present a risk to human health. EPA's acceptable risk range is defined as a cancer risk range of 1×10^{-6} to 1×10^{-4} and an HI < 1. Generally, remedial action at a site is warranted if cancer risks exceed 1×10^{-4} and/or if non-cancer hazards exceed an HI of 1

The BHHRA for the site (including Area 1) presented estimated cancer risks and non-cancer hazards for several populations of anglers consuming fish from the Kalamazoo River and for residential and recreational receptors exposed to floodplain soil adjacent to the former Plainwell, Otsego, and Trowbridge Impoundments.

Risk characterization for anglers was performed for three potential populations: central tendency sports anglers, high-end sports anglers, and subsistence anglers.[3] Two exposure scenarios for the three angler populations were included in the BHHRA: the first assumed a diet of 100 percent pelagic (non-bottom feeding) fish species and the second assumed a mixed species diet (76 percent pelagic species and 24 percent bottom-feeding species).

The BHHRA showed that potential excess cancer risks and non-cancer hazards exceeded acceptable levels for the fish ingestion pathway for all three angler populations. Cancer risks and non-cancer hazards were highest for the subsistence angler (2×10^{-3} and an HI of 123, respectively). Cancer risks and non-cancer hazards were lowest for the central tendency sport angler (3×10^{-4} and an HI of 17, respectively). Adverse health effects associated with PCB exposure include increased risk of liver cancers and reproductive and immunological impairment. The highest risks and hazards are associated with a mixed species diet, and were highest in the vicinity of the recent Area 1 TCRAs described earlier in this document; the BHHRA did not take into account recent reductions of PCB concentrations in sediment and soil due to the TCRAs.

For residents and recreationists potentially exposed to floodplain surface soil, it should be noted that the BHHRA estimated the excess cancer risks and non-cancer hazards based on pre-TCRA concentrations, thereby possibly overestimating the risks and hazards associated with current and future exposures in the TCRA locations.

For the three areas evaluated (i.e., the floodplain areas around the former Plainwell and Plainwell 2 impoundments, the Otsego Dam, and the Trowbridge Dam), estimated risks for residents exposed to average floodplain surface soil concentrations were within EPA's acceptable risk range but were greater than MDEQ's cancer risk threshold of 1×10^{-5}. Excess cancer risk estimates exceeded the acceptable risk range when the maximum detected concentration for each area was used.

[3] Central tendency sports anglers were estimated to consume an average of 0.015 kg fish tissue/day (24 half-pound meals/year). High-end sports anglers were estimated to consume 0.078 kg fish tissue/day (125 half-pound meals/year). Subsistence anglers were estimated to consume 0.11 kg fish tissue/day (179 half-pound meals/year).

For residential receptors exposed to floodplain soil via multiple routes (i.e., ingestion, dermal contact, and inhalation of fugitive dust), HIs for the reproductive endpoint exceeded 1 for all three areas when maximum concentrations were used, but were less than 1 using average floodplain soil concentrations. HIs for immunological endpoints exceeded 1 for all three areas using both average and maximum floodplain soil concentrations.

Excess cancer risks and non-cancer hazards for recreationists exposed to average floodplain surface soil concentrations were within EPA's acceptable risk range and less than MDEQ's cancer risk threshold of 1×10^{-5} in all three areas evaluated. Potential cancer risks were still within EPA's acceptable risk range when the maximum floodplain soil concentration was used, but were greater than MDEQ's cancer risk threshold. HIs were greater than 1 when maximum soil concentrations were used.

As noted earlier, fish advisories are currently in place to address risks to humans from consumption of fish. There are currently no restrictions in place to control human exposures to sediment, soil, or surface water.

In summary, the fish ingestion pathway poses unacceptable risks and hazards to anglers. Additionally, potential exposure to maximum floodplain soil concentrations may pose unacceptable risks and hazards to residents and recreationists. The highest risks from exposure to floodplain soils are 2- and 25-times lower than those for the central tendency sports angler and subsistence angler scenarios, respectively. The BHHRA made assumptions using best professional judgment and available scientific literature on risk assessments. The risk assessment for floodplain surface soil was based on pre-TCRA soil concentrations, which would tend to overestimate current and future risks for residents and recreationists. The overall risk to human health attributable to Area 1 is an upper-bound *probability* of adverse health effects, not a statement of actual health effects.

Baseline Ecological Risk Assessment

As part of the original RI, CDM prepared a baseline ecological risk assessment (BERA) for OU5 that identified terrestrial and aquatic receptors and exposure pathways. During the SRI, an updated Area 1 terrestrial BERA (TBERA), covering terrestrial birds and mammals, was conducted and included as Appendix B to the Area 1 SRI Report. The methods and approaches incorporated in the Area 1 TBERA built on the information in the BERA and the CSM. The TBERA also accounted for updated risk assessment guidance and scientific research, additional sampling results, a December 2008 peer review panel report, two completed TCRAs in Area 1, and source control activities completed or underway at the former mill properties and landfill OUs in Area 1 since the BERA was completed. The Area 1 TBERA did not revisit the aquatic portion of the BERA but carried forward those associated conclusions.

<u>Summary of OU5 BERA</u>

The BERA was conducted to evaluate potential adverse effects to terrestrial and aquatic ecological receptors associated with PCB exposures in surface water, sediment, surface soil, and

biota. Representative ecological receptors included aquatic plants, aquatic macroinvertebrates, game fish, forage fish, rough fish, terrestrial invertebrates, small burrowing omnivorous mammals, semi-aquatic herbivorous mammals, small semi-aquatic carnivorous mammals, and top mammalian and avian predators. The BERA evaluated complete exposure pathways that included the following:

- Surface water – direct contact, uptake, ingestion, or ingestion of prey
- In-stream sediment/interstitial water – direct contact, ingestion, or ingestion of prey
- Surface soil/floodplain sediment and soil – direct contact, ingestion, or ingestion of vegetation/prey

The BERA concluded the following:

- Most aquatic biota, such as invertebrates and fish, are not expected to be adversely affected by direct contact with and ingestion of surface water because of relatively low PCB toxicity to most aquatic biota.
- PCB contamination of surface water and streambed sediment may adversely affect sensitive piscivorous predators, such as mink, through the consumption of PCB-contaminated fish.
- Terrestrial and semi-aquatic biota are potentially at risk from floodplain sediment and surface soil, depending on life cycle characteristics (e.g., foraging behavior, diet, mobility) and predicted sensitivity to PCBs.

Summary of Area 1 TBERA

The development of the Area 1 TBERA was a coordinated effort among GP, EPA, the State of Michigan, and the U.S. Fish and Wildlife Service. The participants agreed on key inputs and elements of the terrestrial assessment, including establishing the focus of the Area 1 TBERA on the former Plainwell Impoundment and the Plainwell No. 2 Dam Area. These two areas were the focus of recently-completed TCRAs that addressed PCBs, so the participants agreed to focus on assessing residual risks to terrestrial receptors associated with PCB exposure via the food chain in those two areas. Representative receptors were selected as the most highly-exposed species likely to inhabit Area 1. The representative receptors included insectivorous birds (house wren), vermivorous mammals (short-tailed shrew), vermivorous birds (American robin and American woodcock), carnivorous mammals (red fox), and carnivorous birds (red-tailed hawk).

To evaluate risks for receptors with individual foraging ranges smaller than the two assessment areas (i.e., the American robin, American woodcock, house wren, and short-tailed shrew), a "moving-window" approach was used to approximate the receptor-specific exposure units. This approach provides a continuous measure of exposure for each predetermined home range size across the entire area instead of non-overlapping, discrete home ranges. Exposure point concentrations (EPCs) for wide-ranging receptors (i.e., red fox and red-tailed hawk) were assessed for the two areas separately using unbiased floodplain soil data. Area-wide EPCs were estimated as an area-weighted mean. At the request of EPA, risk associated with exposure to dioxin (specifically, dioxin toxicity equivalence or TEQ) was also considered for a subset of the receptors/exposure scenarios.

HQs[4] were calculated using three approaches to model potential PCB exposure to terrestrial wildlife. Approach 1, the Dietary Approach, estimated average daily doses based on floodplain soil and tissue ingestion, and was calculated for both total PCBs (birds and mammals) and TEQs (small mammals only). The other two approaches, for birds only, were included at the request of EPA. In Approach 2 (Egg-Based Approach), egg-based exposure to both PCBs and TEQs for robins, woodcocks, and house wrens was estimated by modeling egg tissue concentrations from floodplain soil concentrations using a bioaccumulation factor (BAF). An alternate Egg-Based Approach via Dietary Ingestion (Approach 3) was also used to estimate egg-based exposure by incorporating a dietary exposure model to estimate egg tissue TEQ concentrations for the American robin (i.e., using a floodplain-soil to soil-invertebrates to egg BAF). Avian receptor evaluations included HQs based on high-sensitivity and mid-range-sensitivity toxicity reference values (TRVs). A TRV is a quantitative measure of the toxicity of a chemical to the species of concern, and the TBERA utilized TRV information from research literature. More detailed information regarding the TBERA is available in the Area 1 TBERA Report.

The Area 1 TBERA conclusions are summarized as follows:

- Risk to vermivorous mammals is possible, but unlikely based on the low magnitude of shrew HQs (maximum Lowest Observed Adverse Effects Level (LOAEL) HQ of 1.2), low frequency of possible home ranges with LOAEL HQs greater than 1.0, and the results of the Housatonic River[5] shrew study. Based on estimated No Observed Adverse Effects Level (NOAEL) dietary HQs, carnivorous mammals (represented by the red fox with a home range more than ten times as large as either area) have acceptable risks that are well below 1.0 for both the former Plainwell Impoundment and the Plainwell No. 2 Dam Area.
- Moderate- to low-sensitivity insectivorous birds (represented by the house wren) are not at risk.
- High-sensitivity insectivorous birds (also represented by the house wren) have a potential for risk based on the egg-based HQs (Approach 2), but unacceptable risk is not likely based on dietary HQs (Approach 1).
- Highly-exposed (i.e., greater than 40% terrestrial invertebrates), moderate- to low-sensitivity vermivorous birds (represented by the American robin) are not considered at risk.
- Highly-exposed, moderate- to low-sensitivity vermivorous birds (represented by the American woodcock) are not considered at risk.

In summary, risk to vermivorous avian species in Area 1 is considered unlikely based on mid-range sensitivity TRVs because LOAEL HQs were less than 1.0. High-sensitivity TRVs resulted in HQs greater than 1.0 for both dietary (in former Plainwell Impoundment only) and egg-based exposures; however, no small-ranging, highly-exposed, high-sensitivity vermivores have been

[4] The meaning of an HQ was previously described in the "Baseline Human Health Risk Assessment" section of this Proposed Plan.

[5] The Housatonic River is a Superfund site in western Massachusetts and Connecticut with PCB-contaminated sediments and soils."

observed at the site in over 30 years of surveys conducted by the Kalamazoo River Nature Center. Given the low probability that highly-exposed (i.e., greater than 40% terrestrial invertebrates in diet), high-sensitivity avian vermivores are present in Area 1, ecologically significant adverse effects on vermivorous birds in Area 1 is possible, but not likely. Carnivorous birds (represented by the red-tailed hawk) are not considered to be at risk.

Basis for Taking Action

It is EPA's current judgment that the Preferred Alternatives for sediment and floodplain soil identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan for sediment and/or floodplain soil, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

6. REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are goals for protecting human health and the environment. RAOs are developed to address the contaminant levels and exposure pathways that present unacceptable current or potential future risk to human health and the environment. The development of RAOs and proposed cleanup levels, known as preliminary remediation goals (PRGs), is the first step in identifying and screening remedial alternatives for addressing the COCs and media of concern.

Remedial Action Objectives for Area 1

The following four RAOs have been developed for PCB-containing media in Area 1:

- **RAO 1: Protect people who consume Area 1 Kalamazoo River fish from exposure to PCBs that exceed protective levels.** This RAO is expected to be progressively achieved over time by meeting the following targets for fish tissue and sediment:
    - Reduction in fish tissue to the Michigan fish advisory level for smallmouth bass to two meals per month (0.11 mg/kg total PCB concentration) within 30 years[6]
    - Achievement of a non-cancer HI of 1 and a 10^{-5} cancer risk within 30 years for the high-end sport angler (100 percent bass diet; 125 meals/year)[7]
    - The above fish tissue goals for bass will be achieved by reducing the sediment PCB SWAC in each of the eight sections of the river in Area 1 to 0.33 ppm or less following completion of the remedial action
- **RAO 2: Protect aquatic ecological receptors from exposure to concentrations of PCBs in sediment that exceed protective levels for local populations.** This RAO is designed to protect fish-eating birds and mammals by reducing fish tissue PCB concentrations to levels that do not harm the sustainability of local populations of these receptors[8].

[6] This specific target is a goal of the remedial action, but it is not a PRG.

[7] The non-cancer and cancer risk levels described here are what drive the PRGs for RAO 1.

[8] See the PRG table on page 24.

- **RAO 3: Protect terrestrial ecological receptors from exposure to concentrations of PCBs in soil that exceed protective levels.** This RAO is intended to protect local populations of birds and mammals by reducing PCB concentrations in soil to levels that do not harm the sustainability of local populations of these receptors.
- **RAO 4: Reduce transport of PCBs from Area 1 to downstream areas of the Kalamazoo River and Lake Michigan.** This RAO includes reducing the potential for erosion and downstream migration of PCB-impacted sediment and riverbank soil.

Preliminary Remediation Goals

PRGs are risk-based or ARAR-based chemical-specific concentrations that help further define the RAOs. PRGs are considered "preliminary" remediation goals until a remedy is selected in a ROD. The ROD establishes the final remedial goals and/or cleanup levels. PRGs are also used to define the extent of contaminated media requiring remedial action, and are the targets for the analysis and selection of long-term remedial goals.

The BHHRA developed a series of risk-based concentrations (RBCs) for total PCBs in fish, sediment, and floodplain soil intended to be protective of anglers, recreationists, and residents, while the BERA and TBERA developed RBCs for sediment and floodplain soil intended to be protective of sensitive wildlife receptors. The RBCs are calculated, chemical-specific concentrations below which no significant health effects are anticipated for a receptor. For human receptors, Area 1 RBCs correspond to a target risk for carcinogenic effects of 1×10^{-5} and a target hazard index of 1 for non-carcinogenic effects. For ecological receptors, RBCs correspond to a target HQ of 1. RBCs for ecological receptors represented a risk range based on NOAEL and LOAEL risk estimates for each receptor group.

Selection of Fish Tissue Preliminary Remediation Goals

The selection of a fish tissue PRG was a multi-step process that considered the RBC_{fish} values generated for each receptor, the likely exposure scenario to be frequently encountered, and the background levels of PCBs in fish tissue. Although a subsistence angler scenario was included in the calculation of RBC_{fish}, this pathway represents a worst-case scenario that is not expected to be frequently encountered compared to sport anglers. The RBC_{fish} would likely reflect a diet that is weighted toward the 100 percent smallmouth bass consumption scenario (over a mixed carp and bass species scenario) because the smallmouth bass is a popular sport fish on the Kalamazoo River. The range of RBC_{fish} for sport anglers is from 0.042 mg/kg to 0.187 mg/kg (non-lipid corrected). The upper end of this range is similar to the mean background concentration in smallmouth bass fillets in Morrow Lake immediately upstream of Area 1 (0.23 mg/kg). Another background reference area further upstream of Area 1 (Ceresco) had mean smallmouth bass fillet concentrations of 0.03 mg/kg. The upper end of this range is also protective of women of childbearing age and young children consuming one half-pound meal a month from the site.

For RAO 1, the recommended fish tissue PRGs for total PCBs are 0.042 mg/kg for carcinogenic effects (based on a risk of 1×10^{-5}) and 0.072 mg/kg for non-carcinogenic effects (based on an

HI of 1). These PRGs are based on risk estimates to sports anglers and sensitive populations, and take into account background considerations[9].

For RAO 2, the recommended fish tissue PRG for total PCBs is 0.6 mg/kg, which is protective of mink (the most sensitive ecological receptor).

Selection of Sediment PRGs

The selection of a sediment PRG considered the human health RBC_{sed} values associated with the human receptors who consume fish. MDEQ conducted an independent evaluation and has recommended a sediment PRG of 0.33 mg/kg. MDEQ concluded that this PRG value is appropriate for sediment because it is sufficiently protective of the high-end sports angler. This PRG value also corresponds to MDEQ's historical PCB detection limit that has previously been used as a screening and target level in Michigan, and that has become a precedent value in the state for PCB site cleanup efforts under Michigan's Natural Resources and Environmental Protection Act, Part 201. Further, this PRG is close to the mean background sediment concentration of 0.31 mg/kg.

A PRG of 0.33 mg/kg is protective of both human and ecological receptors. Sediment concentrations below 0.33 mg/kg are not likely to bioaccumulate in fish tissue to levels that present unacceptable risks and hazards to human populations, and will promote the achievement of the fish tissue RAOs over time.

Selection of Floodplain Surface Soil PRGs

The selection of a floodplain surface soil PRG was based on the range of site-specific RBC_{soil} values calculated for human recreationists and ecological receptors, with the ecological RBC_{soil} values driving the selection of the PRG because they were much lower than the values for human receptors. Although ecological risk was predominantly associated with high-sensitivity insectivorous and vermivorous birds and vermivorous mammals in the Area 1 TBERA, a range of RBC_{soil} was calculated based on the protection of multiple wildlife receptors. A detailed analysis of the uncertainty associated with the TBERA RBCs is provided in Attachment 1 of Appendix G of the FS Report.

A PRG of 11 mg/kg is based on protectiveness of 1-acre home ranges for maximum exposed mammals. Based on the analysis presented in the Area 1 FS Report and the post-TCRA conditions at the former Plainwell Impoundment, a PRG of 11 mg/kg is shown to currently be protective of 82% of the possible 1-acre home ranges within the former Plainwell Impoundment for maximally exposed mammalian receptors (i.e., the shrew). Current post-TCRA conditions at the Plainwell No. 2 Dam Area are protective of 100% of the possible 1-acre shrew home ranges. A PRG of 11 mg/kg PCBs is also assumed to be protective of avian receptors as it represents a balance between risk and uncertainty associated with the various methodologies and assumptions

[9] The high-end sports angler is assumed to consume 125 meals/year.

used in the TBERA to calculate risk to avian receptors.[10] Evaluation of the dietary and/or egg-based RBCs indicates that the proposed PRG of 11 mg/kg in floodplain soil is protective of the various ecological receptors.

A floodplain soil PRG of 11 mg/kg is also protective of human recreational receptors. However, for floodplain surface soil in current or potential residential use areas, a PRG of 2.5 mg/kg is recommended to protect residential receptors.

Summary of PRGs

The table below summarizes the various PRGs that are proposed for Area 1. The ability to meet the various risk-based fish tissue PRGs will be evaluated during the five-year review process following the Area 1 remedial action. These reviews will consider factors identified during LTM that may limit overall fish tissue and sediment recovery (e.g., fish tissue or sediment concentrations approaching background levels, which include atmospheric deposition and/or other non-site sources of PCBs to the river system).

Recommended PRGs for Area 1 of OU5	
Media	**PRG for Total PCBs**
Fish Tissue	0.042 mg/kg (RAO 1, cancer risk of 1 x 10^{-5}) 0.072 mg/kg (RAO 1, non-cancer HI of 1) 0.6 mg/kg (RAO 2, ecological receptors)
Sediment	0.33 mg/kg (SWAC in each river section)
Floodplain Soil	11 mg/kg (all areas except residential) 2.5 mg/kg (residential areas)

Remediation Areas

For purposes of developing potential remedial alternatives, the FS identified the various sediment and floodplain areas that would require remediation based on the RAOs and PRGs that were developed for Area 1.

Sediment Remediation Areas

The PCB SWAC analysis was used as a screening tool to evaluate the distribution of PCBs and to identify potential remediation locations in Area 1. The SWACs provide predictions of the average exposure concentration in a specified area. The SWACs for Sections 1 through 8 (shown in Table 1) are based on limited (i.e., widely-spaced) data. Additional samples will be collected in the areas targeted for remediation during RD to further define the sediment remediation area.

[10] A PRG of 11 mg/kg is below the dietary high-sensitivity RBCs calculated for the house wren and American robin and within the mid-range and high-sensitivity dietary RBCs calculated for the American woodcock. For the American woodcock, a PRG of 11 mg/kg is within the mid-range sensitivity dietary RBCs and above the high-sensitivity dietary RBCs. A PRG of 11 mg/kg falls between the egg-based RBCs for mid-range and high-sensitivity avian receptors.

The results of the SWAC analysis show that the PCB SWAC in Section 3 was relatively high compared to the other sections. As a result, Section 3 was selected as a candidate for remedial action evaluation. The sediment PRG would be met by reducing the SWACs to 0.33 mg/kg through the removal of sediment and/or through natural recovery processes.

The calculated SWACs for the Crown Vantage side channel are 8.2 mg/kg. Therefore remedial alternatives also were developed for that area.

The Portage Creek TCRA has not yet met the sediment PRG (the post-TCRA SWAC was 1.8 mg/kg) but is expected to meet it over time through natural recovery processes. Therefore, no further active cleanup measures are proposed for that section of Area 1.

As noted earlier in this Proposed Plan, the Section 8 SWACs were calculated using primarily pre-TCRA data and, as a result, are not representative of current conditions. The current conditions in Section 8 of Area 1 will be further evaluated during RD.

In addition to the SWAC analysis, a geomorphic-PCB analysis was conducted. Based on that analysis, remedial alternatives were developed for known hot spot areas (i.e., areas with multiple samples showing PCB concentrations greater than 50 mg/kg) in Section 3, as well as for known hot spot areas in Sections 2 and 4 (even though the SWACs for Sections 2 and 4 are less than or near 1 mg/kg). The geomorphic-PCB analysis also indicated higher PCB concentration along the edges of the river channel relative to the middle of the river channel in Section 3, so those areas along the edges of the river channel in Section 3 were also selected for further evaluation.

Based on the above evaluations, the portion of Area 1 spanning the hot spots in Sections 2, 3, and 4, and including the areas within Section 3 with higher concentrations along the edges of the river channel, were designated as the Remedial Reach (see Figure 5). Remedial alternatives were then developed for the Remedial Reach and the Crown Vantage side channel. Additional sampling will be conducted during the RD to evaluate whether other areas within the Remedial Reach – besides the known hot spots – require remediation. Additional sampling during RD is included with all sediment remedial alternatives (described in the "Summary of Remedial Alternatives" section below) except the MNR alternative.

Floodplain Soil Remediation Areas

During the FS, EPA, MDEQ and GP evaluated a range of potential remedial action level (RAL) values for soils. A RAL is a value that would trigger cleanup. In Area 1, the concept is that cleanup of floodplain soil would be triggered based upon the number of potential 1-acre home ranges[11] exceeding the floodplain soil PRG (11 mg/kg). Potential RALs were evaluated based on an assessment of the following factors: the incremental risk reduction that would be achieved; the desire to protect 95% to 100% of the receptors (shrew, wren, and robin under the dietary model); and the incremental area and soil volume associated with each value. As a result of that

[11] The maximally exposed mammalian receptor, the shrew, has a smaller home range (1 acre) than the maximally exposed avian receptors (which have home ranges of 2 acres), so 1 acre was chosen as the area to which a RAL would be applied.

evaluation, a RAL of 20 mg/kg is proposed for floodplain soil since it provides the greatest incremental risk reduction. A RAL of 20 mg/kg was applied to the former Plainwell Impoundment and Plainwell 2 Dam areas. However, a floodplain soil remedial alternative using a RAL of 0.5 mg/kg also was developed for comparison purposes.

Based on the findings of the SRI and the nature and extent of floodplain soil contamination (discussed earlier in this Proposed Plan), floodplain soils in the former Plainwell Impoundment and the Plainwell No. 2 Dam Area were selected for further evaluation. Available floodplain soil data from the former Plainwell Impoundment show that the area exceeding a RAL of 20 mg/kg comprises approximately 7 acres and 15,000 cy of floodplain soil. Current soil concentrations in the Plainwell No. 2 Dam Area do not exceed a RAL of 20 mg/kg.

As discussed in the "Remedial Action Objectives" section of this Proposed Plan, a floodplain soil PRG of 11 mg/kg is recommended to protect ecological and human recreational receptors, and a separate PRG of 2.5 mg/kg is recommended to protect human residential receptors. The available data from areas within Area 1 representative of potential residential exposure were evaluated, and show that nearly all of the natural floodplain areas appear to meet the residential PRG. However, the data are limited, and more data are needed to determine whether any of the natural floodplain areas exceed the residential PRG.

7. SUMMARY OF REMEDIAL ALTERNATIVES

A range of alternatives was developed for soil and sediment to achieve Area 1 RAOs. Remedial alternatives were developed by assembling combinations of appropriate remedial technologies. Although the floodplain soil and sediment alternatives are related, to simplify the evaluation the alternatives are being presented and evaluated as two separate groups. The Area 1 sediment and floodplain soil alternatives are described below. Additional details are available in the Area 1 FS Report.

EPA is recommending that Sediment Alternative S-3A and Floodplain Soil Alternative FPS-4A be selected as the remedy for Area 1 of OU5.

Common Elements

Components that are common to all of the alternatives except the "no further action" alternatives are presented here as a group in order to limit redundancy in the subsequent discussion of the individual alternatives. These common components are:

- All active remedial alternatives include a long-term monitoring program. In addition to an LTM program, all active remedial alternatives include maintenance of institutional and erosion controls (i.e., ICs and ECs) until long-term goals are achieved;
- Active remedial alternatives also include additional sampling in Section 8 to document post-TCRA conditions and additional sampling for hot spot areas from RM70.5 to RM71.25 and at RM71.65 (Portage Creek confluence);
- Identification of the remedial area footprints will be confirmed through additional sampling during the RD;

- The LTM program will confirm the ongoing effects of natural processes and document the continued declines in PCB concentrations in various media, resulting in reductions in risk and ecological exposures. It is anticipated that the monitoring program will be designed to supplement the current program that includes fish and water column monitoring.
- The final components of the LTM program will be defined during the RD; however, for developing cost estimates it is assumed that the LTM program would include the following activities:
    - Fish monitoring annually for the first five years, then once every five years for the remainder of the LTM period. Fish samples would be collected within locations spanning Area 1 and the reference/background areas. The actual sampling locations would be specified during the RD. Smallmouth bass and carp would be collected at each sampling location. Adult carp and both adult (fillet) and young-of-year (whole body) smallmouth bass would be collected and analyzed for total PCBs and lipid content.
    - Surface water quality monitoring would occur annually for the first five years then once every five years for the remainder of the LTM period to support EPA's five-year reviews. Samples would be collected representing each of the eight Sections of Area 1. Water samples would be analyzed for total PCBs.
    - Sediment samples would also be collected to support EPA's five-year reviews by monitoring ongoing recovery conditions and natural attenuation in selected portions of Area 1. A sampling plan for surface water, fish, and sediment would be developed and approved by EPA during RD.
    - Visual inspections of riverbank erosion would occur annually for the first five years then once every five years for the remainder of the LTM period. Additional inspections would be conducted after major storm/flooding events, as necessary.
- Site-specific fish consumption advisories established and publicized by the State of Michigan will continue to manage risks posed to anglers and their families from consumption of PCB-containing fish. These advisories are already in place for Area 1, and the advisory for each fish type will remain in effect until fish tissue PCB concentrations achieve RAOs for the fish specified. The advisories will be reviewed and verified annually as a component of the site ICs. The fish consumption advisories issued by MDCH are only a recommendation, are not legally binding, and have limited effectiveness in protecting human health. Fish advisories, alone, would not be an appropriate remedial alternative.
- Use of a proposed RAL of 20 mg/kg for most of the floodplain soil alternatives. The RAL value of 20 mg/kg is based on an assessment of the following factors: the incremental risk reduction that would be achieved; the desire to protect 95% to 100% of the receptors (shrew, wren, and robin under the dietary model); and the incremental area and soil volume associated with each potential RAL value. Selecting a RAL of 20 mg/kg provided the largest incremental risk reduction in the impounded floodplain areas and was used to develop floodplain soil alternatives. However, a floodplain soil remedial alternative using a RAL of 0.5 mg/kg also was developed for comparison purposes.

- Additional sampling will be conducted to determine whether any of the natural floodplain areas exceed the residential PRG.

Sediment Remedial Alternatives

S-1: No Further Action

Regulations governing the Superfund program require that the "no action" alternative be evaluated generally to establish a baseline for comparison. The No Further Action remedial alternative, S-1, would rely on natural recovery processes following the TCRAs and various OU source control activities previously completed and/or ongoing in and next to Area 1. No active remediation or monitoring would be conducted under this alternative. The time to reach protective levels and compliance with PRGs is estimated to be a minimum of 87 years, but no monitoring would be conducted to document progress toward achievement of PRGs. No cost is associated with this alternative.

S-2: MNR, ICs, and ECs

This alternative applies monitored natural recovery and institutional controls/engineering controls. It relies on natural recovery processes following the completed and/or ongoing active remediation activities (i.e., the TCRAs and various OU source control activities in and adjacent to Area 1) for further improvements beyond current conditions in Area 1 sediment, including progress toward achieving RAOs. These processes include deposition of cleaner sediment from the watershed, mixing of surface and cleaner sediment, and, possibly, biodegradation. MNR would include implementation of an LTM program to confirm the ongoing effects of natural processes and document the continued declines in PCB concentrations in various media, as described above. Existing ICs/ECs (fish consumption advisories and warning signs) would continue under this alternative. The time to reach protective levels and compliance with PRGs under Alternative S-2 is estimated to be a minimum of 87 years after ROD issuance. Cost is estimated at $2,700,000.

S-3A: Removal of Hot Spot Areas and Crown Vantage Side Channel, MNR, ICs, and ECs – EPA'S RECOMMENDED SEDIMENT ALTERNATIVE

Alternative S-3A includes the removal of impacted sediment in at least five hot spot areas and the Crown Vantage side channel, with MNR, ICs and ECs throughout Area 1. The five identified hot spots (identified on Figure 5 as KPT-19, KPT-20, KRT-4, KRT-5/FF-19, and S-IM1) are located within the stretch of Area 1 known as the Remedial Reach (spanning from RM69.3 to RM72.3). The Remedial Reach includes Section 3 and the adjacent portions of Sections 2 and 4 (see Figure 5). Additional sampling of the Remedial Reach would be performed during RD to further delineate the removal boundaries around the known hot spots and to identify other locations for remediation within the Remedial Reach.

The upper end of the cost estimate range for this alternative includes the remediation of two additional, currently unknown hot spots, in the event that additional hot spot areas are identified during RD. The mass of PCBs that would be removed from the river through this alternative is estimated to be approximately 390 kg. The anticipated average removal depth in the identified hot spots ranges from 24 to 40 inches, based on current data from the Remedial Reach. The estimated total volume that would be removed is approximately 19,500 cy.

The cost estimate for this alternative assumed that residuals management in the form of a thin-layer cap[12] addition would occur in approximately 50% of the area. The need for and effectiveness of a thin-layer cap would be evaluated during RD. LTM and ICs/ECs would be implemented until PRGs are achieved.

Alternative S-3A assumes a construction season of 8 months per year, with construction activities following design, permitting, and obtaining the necessary land access agreements. Typical silt curtain controls and surface water monitoring would be employed for turbidity and PCB migration from removal areas. Calculations show that the SWAC for the Remedial Reach would be reduced from 1.76 mg/kg to 1.09 mg/kg PCB following the remedial action work. This alternative would then rely on natural recovery processes to achieve the PRGs and RAOs over time, and would include LTM.

Restoration would be conducted where disturbances to the existing vegetation and natural habitats would occur within upland, wetland, and riverbank areas due to the construction of support facilities and implementation of remedial activities. Excavated channel edges would be stabilized, and formerly vegetated upland areas that are disturbed for river access would be restored in kind with topsoil and revegetated with native seed mixes and woody plantings.

Removal of PCB-containing sediment would also serve to remove other constituents detected in Area 1 sediment, including organic constituents and metals. Removal, along with an assumed thin-layer cap addition for management of residuals, would provide protection to ecological receptors from exposure to PCBs as well as these other constituents. The collocation of non-PCB constituents with PCBs in the sediment does not imply that they came from a similar source area or that they are related to paper mill recycling processes. Rather, their collocation is likely a result of shared fate and transport mechanisms.

This alternative would reach PRGs for smallmouth bass within 32 years after ROD issuance. The time to complete construction would be approximately 1 to 2 years, at an estimated cost of $13,100,000 to $16,600,000 (depending on the number of hot spot areas to be remediated).

S-3B: Removal of Hot Spot Areas, In-Situ Capping for Crown Vantage Side Channel, MNR, ICs, and ECs

Alternative S-3B includes the same activities described above for Alternative S-3A for removing 15,600 cy of sediment in the known hot spot areas in the Remedial Reach, but would cap rather than remove the sediment in the Crown Vantage side channel. The cap for the Crown Vantage side channel would cover approximately 1.2 acres.

The Crown Vantage side channel was evaluated for capping activities because this area represents an environment that is amenable to capping. It lies outside the main river channel and is a backwater except during flooding events. Under Alternative S-3B, the side channel would be cut off from its connection to the river at the downstream end, capped, and armored to prevent erosion during floods, ice scour, etc. The cap would be designed in accordance with EPA and

[12] Note: the thin layer cap is a 6" sand/gravel cap that may be used in areas after a hot spot is excavated to enhance recovery and serve as backfill. The details will be worked out during RD.

U.S. Army Corps of Engineers guidance to provide long-term isolation and to provide for stability, integrity, and protectiveness. Cap installation would be performed from land using conventional earth moving equipment. The engineered cap would consist of a geotextile layer and a 12-inch-thick sand isolation layer overlain by a 6-inch gravel armor layer. The final cap composition, configuration, and transitions would be determined during RD.

Remedial design sampling and LTM would be the same as for Alternative S-3A, with additional inspection and maintenance for the Crown Vantage side channel area cap. This alternative assumes that additional ECs for erosion control would be needed.

This alternative would reach PRGs for smallmouth bass within 32 years after ROD issuance. The time to complete construction would be approximately 1 to 2 years, at an estimated cost of $12,200,000 to $15,700,000 (depending on the number of hot spot areas to be remediated).

S-4A: Removal of Hot Spot Areas, Crown Vantage Side Channel, and Section 3 River Channel Edges, MNR, ICs, and ECs

Alternative S-4A includes the same activities described above for Alternative S-3A, but would also excavate sediment along the edges of the Section 3 river channel that exceeds 1 mg/kg total PCBs. The total estimated removal volume for the four hot spot areas, Crown Vantage side channel, and the Section 3 channel edges is 63,900 cy, spanning approximately 15 acres. The edge removal in Section 3 would span roughly 80% of each bank, or 1.4 miles along each side of the river. The mass of PCBs that would be removed from the river edges is an additional 54 kg above that estimated in Alternative S-3A, for a total estimated mass of 444 kg of PCBs removed. Calculations show that the SWAC for the Remedial Reach would be reduced from 1.76 mg/kg to 0.6 mg/kg PCB following the remedial action work. This alternative would then rely on natural recovery processes to achieve the PRGs and RAOs over time. Remedial design sampling and LTM would be the same as other sediment alternatives, with additional EC inspections and erosion control maintenance for the Section 3 edges.

This alternative would reach PRGs for smallmouth bass within 25 years after ROD issuance. The time to complete construction would be approximately 4 years, at an estimated cost of $33,700,000 to $37,200,000 (depending on the number of hot spot areas to be remediated).

S-4B: Removal of Hot Spot Areas and Section 3 Channel Edges, In-situ Capping for Crown Vantage Side Channel, MNR, ICs, and ECs

Alternative S-4B includes the same activities described above for Alternative S-4A for removing 59,900 cy of sediment in the known hot spot areas and Section 3 river edges, but would cap rather than remove the sediment in the Crown Vantage side channel (as described in Alternative S-3B). The cap for the Crown Vantage side channel would cover approximately 1.2 acres. Remedial design sampling and LTM would the same as for Alternative S-3B, with additional EC inspections and erosion control maintenance for the Section 3 edges.

This alternative would reach PRGs for smallmouth bass within 25 years after ROD issuance. The time to complete construction would be approximately 4 years, at an estimated cost of $32,300,000 to $35,800,000 (depending on the number of hot spot areas to be remediated).

S-5: Area 1-Wide Removal (RAL 1), MNR, ICs, and ECs

Alternative S-5 includes the removal of sediment exceeding a RAL of 1 mg/kg total PCBs throughout the river in Area 1. The extent of excavation required for this alternative was estimated in two ways to provide remediation area and volume ranges associated with this alternative. The lower bound was estimated using the stream tube geometry created for the Area 1 SWAC calculations, in conjunction with different excavation depth assumptions for river sediments based on available information, and assuming an excavation depth of 24 inches for the Crown Vantage side channel. The upper bound was estimated by assuming that a gross average of 12 inches would be excavated from about 60% of Area 1, including all of the fine-grained sediment areas (estimated to be about 20% of the total Area 1 surface area) plus half of the remaining surface area comprised of medium and mixed/distributed coarse/fine-grained sediment. Bank sediment/soils were also included in the upper-bound estimate, resulting in the excavation of about 60% of the total surface area of Area 1, plus the Crown Vantage side channel area. More details regarding these two estimation methods are provided in the Area 1 FS Report.

The calculated lower-bound excavation area and volume calculated for Alternative S-5 is 140 acres and 300,000 cy, respectively. The upper-bound excavation area and volume is 300 acres and 490,000 cy, respectively.

Post-remedial SWAC calculations for Alternative S-5 reflect an Area 1-wide change in SWACs. The sediment PRG (0.33 mg/kg total PCBs) would be achieved upon completion of excavation activities, and removal of PCB-containing sediment would also serve to remove other non-PCB constituents detected in Area 1 sediment.

This alternative would reach PRGs for smallmouth bass within 45 years after ROD issuance. Implementation of this alternative is estimated to require 10 years, utilizing three crews working simultaneously. The estimated cost for this alternative ranged between $202,000,000 and $337,000,000, depending on the size of the area requiring remediation.

Floodplain Soil Remedial Alternatives

FPS-1: No Further Action

The No Further Action alternative considers only the results of removal action and source control activities previously completed in and next to Area 1. Under this alternative, no additional sampling, active remediation, or monitoring would be conducted in the floodplains. Natural recovery processes would occur; however, a rate of deposition for such natural recovery processes is unknown, and no monitoring would be conducted under this alternative. The primary mechanism for natural attenuation of PCBs in surface soil is anticipated to be the deposition of cleaner sediment during periodic flooding events, filtering of storm runoff from upland areas, and accumulation of vegetative debris. This deposition over a very long period of time would eventually become a natural cap, which would reduce the bioavailability of PCBs in floodplain soil.

The time to reach protective levels and compliance with PRGs could be very lengthy, but no monitoring would be conducted, and it is possible that protective levels would never be reached. The cost of Alternative FPS-1 is $0.

FPS-2: MNR, ICs, and ECs

Under Alternative FPS-2, no further active floodplain soil remediation would be conducted beyond the removal action and source control activities previously completed in and next to Area 1. Progress toward achieving PRGs would rely on natural recovery processes and the maintenance of existing ECs. ICs would also be implemented to restrict disturbance of the soil surface to allow these natural recovery processes to occur. Ongoing natural recovery processes would reduce PCB concentrations and risk from exposure over a very long period of time, but these processes would act at relatively slow rates; the actual rate of natural recovery in the floodplains is currently unknown. LTM would be conducted as part of this alternative, including soil core sampling over time and depositional studies to quantify the rate of recovery. Floodplain status inspections would be performed to inspect the previously installed ECs in Area 1 and monitor for erosion.

The time to reach protective levels and compliance with PRGs could be very lengthy, and it is possible that protective levels would never be reached. The cost of Alternative FPS-2 is estimated at $1,300,000.

FPS-3: Capping (RAL 20), ICs, and ECs

Alternative FPS-3 includes capping 7 acres of floodplain soil in the former Plainwell Impoundment with PCB concentrations greater than a RAL of 20 mg/kg in contiguous areas of one-quarter acre or larger, and implementation of ICs/ECs with LTM. The anticipated locations of remedial areas for this scenario are shown on Figure 6; the actual cap areas/footprints would be determined during RD based on additional floodplain soil sampling. Capping would be achieved by placing 6 inches of borrow material and 6 inches of topsoil over the remediation area to provide a new ecological habitat zone (i.e., the top 6 inches), plus a 6-inch buffer. LTM would be required to verify cap performance over time, and periodic maintenance would be carried out as necessary to preserve or restore the integrity of the caps. ICs restricting land use would be implemented for the cap areas to limit disturbance of the caps.

Alternative FPS-3 would result in 98% to 100% of home ranges for ecological receptors being below the floodplain soil PRG of 11 mg/kg. The time to implement this alternative after completion of the design is estimated to be approximately 1 year, at an estimated cost of $3,800,000.

FPS-4A: Removal (RAL 20), ICs, and ECs – EPA'S RECOMMENDED FLOODPLAIN SOIL ALTERNATIVE

Alternative FPS-4A includes the excavation of 11,300 cy of floodplain soil in the former Plainwell Impoundment with PCB concentrations greater than a RAL of 20 mg/kg in contiguous areas of one-quarter acre or larger, the placement of clean backfill/topsoil in excavated areas to restore floodplain grade elevations, and the implementation of ICs/ECs and LTM. The total excavation footprint would be approximately 7 acres (the same as the areas that would be capped under Alternative FPS-3), as shown on Figure 6. The actual excavation areas/footprints would be

determined during RD based on additional floodplain soil sampling. Excavation would be completed to a target standard depth of 12 inches to remove contaminated soil in the ecological exposure zone (i.e., the top 6 inches), plus a 6-inch buffer. A geotextile fabric would be placed over the completed excavation area. Backfill would include 6 inches of fill soil and a minimum 6-inch topsoil cover to support revegetation and restoration of ecological habitat. LTM would be required to evaluate backfill erosion, vegetative cover, and ECs over time. Periodic maintenance would be carried out as necessary to repair or maintain the integrity of these systems. ICs (land use restrictions) would be implemented.

Alternative FPS-4A would result in 98% to 100% of home ranges for ecological receptors being below the floodplain soil PRG of 11 mg/kg. The time to implement this alternative after completion of the design is estimated to be approximately 1 year, at an estimated cost of $6,800,000.

FPS-4B: Removal (RAL 0.5), ICs, and ECs

Alternative FPS-4B includes the excavation of 1,400,000 cy of floodplain soil containing PCBs at concentrations greater than 0.5 mg/kg throughout Area 1, placement of backfill with topsoil, restoration, ECs for erosion, and implementation of ICs. As indicated earlier, a soil remedy with a RAL of 0.5 was developed as a total removal scenario for comparison to other floodplain soil alternatives. Soil sampling for PCBs in the floodplain would be performed prior to or during RD. The total extent of floodplain soil removal would likely encompass approximately 850 acres of riparian habitat to a removal depth of 12 inches, resulting in a total neatline removal volume of approximately 1,400,000 cy. Post-removal backfill consisting of up to 6 inches of borrow fill (700,000 cy) and 6 inches of topsoil (700,000 cy) would be placed over the excavation areas. This alternative would include implementation of an LTM program including inspections to evaluate conditions of the vegetative cover and ECs.

Alternative FPS-4B would achieve the floodplain soil PRG of 11 mg/kg immediately after completion of construction activities. The time to implement this alternative following completion of the design is estimated to be greater than 10 years, at an estimated cost of $486,000,000.

8. EVALUATION OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that EPA is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives. The purpose of this evaluation is to promote consistent identification of the relative advantages and disadvantages of each alternative, thereby guiding selection of remedies offering the most effective and efficient means of achieving site cleanup goals. While all nine criteria are important, they are weighed differently in the decision-making process depending on whether they evaluate protection of human health and the environment or compliance with federal and state ARARs (threshold criteria), consider technical or economic merits (primary balancing criteria), or involve the evaluation of non-EPA reviewers that may influence an EPA decision (modifying criteria). These nine criteria are described below, followed by a discussion of how each alternative meets or does not meet each criterion.

Explanation of the Nine Evaluation Criteria

Threshold Criteria

1. ***Overall Protection of Human Health and the Environment*** addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed by the site are eliminated, reduced or controlled through treatment, engineering, or institutional controls.

2. ***Compliance with Applicable or Relevant and Appropriate Requirements*** addresses whether a remedy will meet the applicable or relevant and appropriate federal and state requirements, known as ARARs.

Primary Balancing Criteria

3. ***Long-Term Effectiveness and Permanence*** refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met.

4. ***Reduction of Toxicity, Mobility, or Volume Through Treatment*** addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

5. ***Short-Term Effectiveness*** addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction of the remedy until cleanup levels are achieved. This criterion also considers the effectiveness of mitigative measures and time until protection is achieved through attainment of the RAOs.

6. ***Implementability*** addresses the technical and administrative feasibility of a remedy from design through construction, including the availability of services and materials needed to implement a particular option and coordination with other governmental entities.

7. ***Cost*** includes estimated capital costs, annual operation and maintenance (O&M) costs, and the net present value of the capital and O&M costs, including long-term monitoring.

Modifying Criteria

8. ***State Agency Acceptance*** considers whether the state support agency supports the preferred alternative presented in the Proposed Plan and concurs with the selected remedy.

9. ***Community Acceptance*** addresses the public's general response to the remedial alternatives and the preferred alternative presented in the Proposed Plan.

Comparison of Alternatives

Each of the nine evaluation criteria are discussed below with respect to the alternatives under consideration for this remedial action. In addition, Tables 3 and 4 provide a qualitative summary of how the sediment and floodplain soil cleanup alternatives, respectively, compare against the first seven criteria; the remaining two criteria will be evaluated following the public comment period for the Proposed Plan. More details regarding the evaluation and comparison of the cleanup alternatives against the nine criteria can be found in the Area 1 FS Report.

Sediment Alternatives

Overall Protection of Human Health and the Environment

Alternatives S-1 and S-2 might eventually be protective of human health and the environment, but the length of time it would take for river sediments to reach protective levels through natural recovery processes is unreasonably lengthy (estimated at 87 years). However, no monitoring would be conducted under Alternative S-1, so recovery rates and the achievement of protective levels for that alternative would not be documented.

Alternatives S-3A and S-3B, which remove PCB-containing sediment in the Area 1 hot spots and which either remove or cap the Crown Vantage side channel sediment, would provide protection of human health and the environment. These alternatives would reduce overall PCB exposure risk to humans and ecological receptors and would support the reduction in PCB concentrations in fish tissue over time.

Alternatives S-4A and S-4B include the removal of the river edges in Section 3 and would provide similar overall protection of human health and the environment as described for Alternatives S-3A and S-3B. Alternatives S-4A and S-4B would reduce overall exposure risk to humans and ecological receptors and support the reduction in PCB concentrations in fish tissue more quickly than S-3A and S-3B because larger volumes of contaminated materials would be removed.

Alternative S-5, which removes sediment exceeding 1 mg/kg PCBs throughout Area 1, would provide protection of human health and the environment, but achieving protection would be hampered by the long construction period (10 years). The extensive construction activities could also negatively impact wildlife habitat.

Compliance with ARARs

Alternatives S-1 and S-2 might eventually meet most ARARs through natural recovery, but it would take between 87 and 192 years for this to occur. Since no monitoring would be conducted under Alternative S-1, compliance with ARARs under that alternative would not be documented.

Alternatives S-3A, S-3B, S-4A, and S-4B would meet ARARs but would require a risk-based disposal equivalency demonstration for compliance with Toxic Substances Control Act (TSCA) ARARs. Appropriate control measures would be implemented during construction such that the substantive requirements of the action- and location-specific ARARs would be achieved.

Alternative S-5 would comply with ARARs, but it would take longer to meet them (compared to Alternatives S-3A, S-3B, S-4A, and S-4B) due to the longer construction period.

Long-term Effectiveness and Permanence

Alternative S-1 would not provide for tracking or confirmation of future achievement of RAOs, so long-term effectiveness would not be demonstrated or documented.

Alternative S-2 might eventually be effective, but it may be 87-192 years before the effectiveness of the remedy can be demonstrated through LTM.

Alternatives S-3A and S-3B would both be effective in the long term and permanent. The degree of long-term effectiveness and permanence of these two alternatives are similar, as both involve the removal of the hot spot areas in the Remedial Reach. Alternative S-3A also removes the Crown Vantage side channel sediment while Alternative S-3B caps that area. Both alternatives then rely on MNR to achieve the PRGs over time. Contaminated sediment excavation in the Remedial Reach and excavation or capping in the Crown Vantage side channel would reduce the overall SWAC, reduce PCB exposure and improve fish tissue concentrations, and remove (or cap) buried PCB-containing sediment that could otherwise be re-exposed or eroded in the future. LTM, ICs and ECs would be required until PRGs are achieved. Alternatives S-3A and S-3B would achieve the fish tissue PRGs for smallmouth bass within 32 years.

The long-term effectiveness of Alternatives S-4A and S-4B are predicted to be similar to S-3A and S-3B. Added LTM and maintenance would be required for ECs to control erosion along the riverbanks and excavated channel areas. Ecological habitat recovery time would be lengthy due to the extent of disturbance in Section 3. However, the time to achieve the fish tissue PRGs for smallmouth bass would be reduced to 25 years.

Alternative S-5 would have a high degree of long-term effectiveness and permanence, as all sediment exceeding a RAL of 1 mg/kg total PCBs would be removed. Sediment PRGs would be met upon completion of 10 years of excavation work, reducing ecological risk and future potential erosion and downstream migration. The time to achieve the fish tissue PRGs for smallmouth bass is estimated at 45 years.

Reduction of Toxicity, Mobility, or Volume through Treatment

None of the sediment alternatives employ treatment technologies to reduce the toxicity, mobility or volume of the contaminated materials. However, Alternatives S-3A, S-3B, S-4A, S-4B and S-5 would remove significant volumes of PCB-contaminated sediment within Area 1, thereby reducing the ability of the PCB-contaminated sediment to be mobilized into the river in the future. Capping of the Crown Vantage side channel (Alternatives S-3B and S-4B) would

decrease the mobility of that PCB-contaminated sediment from entering the river system. Due to the nature of the contamination, the PCB-contaminated sediments do not lend themselves to cost-effective treatment.

Short-term Effectiveness

Alternatives S-1 and S-2 would not have any adverse short-term impacts, as no active construction work is associated with these alternatives. However, no mitigative measures would be in place to reduce exposures to human and ecological receptors, and it would take a very long time (87 to 192 years) until PRGs and RAOs were achieved.

Under Alternative S-3A, the removal of hot spot areas and Crown Vantage side channel materials would result in immediate reductions in sediment SWACs. There is the potential for PCB concentrations in the water column to temporarily increase during implementation of the cleanup due to disturbance of contaminated sediment. This risk would be managed through ECs such as silt curtains, sheet pile, or porta-dams to isolate the sediment-removal work area. Temporary impacts to stream bank and channel bottom habitats during removal would be localized and reversible. Risks to workers during excavation activities would be controlled through safe work practices and training. Potential impacts to the public during implementation of the cleanup work, including disruptions and intrusions to neighboring residents, equipment and truck traffic, and material handling and staging operations, would be managed by monitoring in active work areas, safe work practices, and training. The implementation period for Alternative S-3A would be approximately 1 to 2 years.

The short-term effectiveness of Alternative S-3B would be similar to S-3A, with slightly less construction worker and public risk associated with capping (instead of removing) the sediments in the Crown Vantage side channel. The implementation period for Alternative S-3B would be the same as Alternative S-3A, 1 to 2 years.

The short-term effectiveness of Alternatives S-4A and S-4B are predicted to be similar to each other. These alternatives would have a greater potential for short-term impacts than Alternatives S-3A and S-3B due to the longer construction period (4 years) and increased amount of construction work required. Similar to Alternatives S-3A and S-3B, the removal of contaminated sediment would result in immediate reductions in sediment SWACs. However, under Alternatives S-4A and S-4B, much of the riverbank wooded habitat and channel habitat along the 1.7 miles of Section 3 would be destroyed. Restoration of vegetative cover and habitat/wildlife recovery would be lengthy under these alternatives.

The extensive excavation work throughout Area 1 required by Alternative S-5 would have the greatest degree of short-term impacts because of the long construction period, estimated at 10 years. Compared to the other alternatives, the potential for sediment resuspension and migration during excavation work would be increased under Alternative S-5, with multiple crews working simultaneously, and with work continuing for a decade. The hard armoring required to control in-stream erosion would significantly alter the habitat in the river, and disturbance and/or destruction of sensitive riparian habitat may be necessary due to the need for access routes and

support areas. Truck traffic along local haul routes during sediment removal and transport off-site would be frequent and prolonged.

Implementability

Alternatives S-1 and S-2 could be easily implemented. No active measures are associated with Alternative S-1, and Alternative S-2 would include only LTM and inspections. The ICs and ECs for erosion control currently in place at the TCRA areas would continue to be inspected and maintained under both alternatives.

Alternatives S-3A and S-3B are similar regarding their implementability. Alternative S-3B would be slightly easier to implement than Alternative S-3A, as capping the Crown Vantage side channel would be easier than excavating that areas. However, the capped area in Alternative S-3B would require long-term maintenance. Sediment removal or capping under these two alternatives requires the construction of roads and staging areas to access the various hot spot locations and the Crown Vantage side channel. Sediment removal and dewatering would be performed using conventional equipment, which is readily available. Transport of dewatered material to an approved off-site landfill would be required, and these services are also readily available. Both alternatives are technically and administratively feasible to design and implement.

Alternatives S-4A and S-4B are similar regarding their implementability. Alternative S-4B would be slightly easier to implement than Alternative S-4A, as capping the Crown Vantage side channel would be easier than excavating that area. However, the capped area in Alternative S-4B would require long-term maintenance. In addition to the remedy components and activities included as part of Alternatives S-3A and S-3B (see implementability discussion above), Alternatives S-4A and S-4B would require the construction of additional roads and staging areas on both sides of the river in Section 3 for edge excavation, making these alternatives more challenging to implement than Alternatives S-3A and S-3B. However, both Alternatives S-4A and S-4B are technically and administratively feasible to design and implement.

Alternative S-5 would be the most difficult to implement. The effort required to construct access roads and staging areas along the river would be extensive. Access along all 22 miles of Area 1 would be difficult to achieve, both physically and administratively. Achieving work completion in 10 years (assuming a construction season of 8 months each year) would require three crews working simultaneously. Removal and dewatering of sediments would be performed through the use of conventional equipment, which is readily available. Transport of extensive quantities of dewatered material to an approved offsite landfill would be required, and these services are also available.

Cost

The estimated costs for each alternative have an expected accuracy of +50% to -30%. Costs for the sediment alternatives range from zero to $337 million, as listed below:

Alternative S-1	$0
Alternative S-2	$2,700,000
Alternative S-3A	$13,100,000 to $16,600,000
Alternative S-3B	$12,200,000 to $15,700,000
Alternative S-4A	$33,700,000 to $37,200,000
Alternative S-4B	$32,300,000 to $35,800,000
Alternative S-5	$202,000,000 to $337,000,000

Alternative S-5 is the most costly alternative because 490,000 cubic yards of sediment would be removed throughout Area 1 and transported for offsite disposal. The costs for Alternatives S-3A, S-3B, S-4A, and S-4B are an order of magnitude lower than the cost for Alternative S-5. Other than the "no action" alternative, Alternative S-2 is the least costly alternative because the only remedy components that have associated costs are LTM and inspections.

The final cost estimate for the selected sediment remedy will be developed and refined during the RD.

State Agency Acceptance

The State of Michigan's acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for Area 1 of OU5.

Community Acceptance

The local community's acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for Area 1 of OU5.

Floodplain Soil Alternatives

Overall Protection of Human Health and the Environment

Alternatives FPS-1 and FPS-2 might eventually be protective of human health and the environment, but the length of time it would take to reach protective levels is difficult to estimate. Data regarding depositional rates in the floodplain are not currently available. The time required for deposition of enough clean material over contaminated areas to reach protective levels is not known but could be very lengthy. No monitoring would be conducted under Alternative FPS-1 so any recovery of the floodplain areas would not be documented.

Alternatives FPS-3 and FPS-4A would be protective of human health and the environment. Capping or removal of soil areas greater than one-quarter acre in size that exceed a RAL of 20 mg/kg would result in 98% to 100% of home ranges for ecological receptors being below the 11 mg/kg floodplain soil PRG. Non-PCB constituents including metals and organic compounds are collocated with PCBs in Area 1 soil, so capping or removal would also protect ecological receptors from exposure to those constituents.

Alternative FPS-4B also would be protective of human health and the environment. Removal of soil areas greater than one-quarter acre in size that exceed a RAL of 0.5 mg/kg, estimated to require the excavation of 1,400,000 cy of floodplain soil, would result in all floodplain soils within Area 1 achieving the PRG. However, such protectiveness would come at the cost of destruction of 850 acres of riparian habitat along approximately 17 miles of river.

Compliance with ARARs

Alternatives FPS-1 and FPS-2 might eventually comply with ARARs, but for the same reasons discussed above, it is difficult to predict when such compliance would occur. No monitoring would be conducted under Alternative FPS-1 so any recovery of the floodplain areas to levels that comply with ARARs would not be documented. Alternative FPS-2 would require additional data collection in the future to establish depositional rates and time to reach chemical-specific ARARs. An equivalency demonstration to show compliance with TSCA ARARs would be required to allow PCB concentrations to remain in place without deed/access restrictions.

Alternatives FPS-3 and FPS-4A would comply with ARARs, but Alternative FPS-3 would require a waiver to disturb the riparian stream buffer/floodplain area, potentially increasing the elevation in the floodplain with the cap. Alternative FPS-3 would also require a site-specific TSCA equivalency demonstration and deed/access restrictions to leave in place PCB concentrations outside the range of acceptable risk to a resident.

Alternative FPS-4B also would comply with ARARs, but it could be difficult to obtain a waiver for destruction of 850 acres of riparian habitat.

Long-term Effectiveness and Permanence

Alternatives FPS-1 and FPS-2 might eventually be effective in the long term, but it is difficult to predict when that might occur. Natural recovery rates in the floodplains are not currently known and would not be documented under Alternative FPS-1. Although the effectiveness of Alternative FPS-2 also is not known, the rate of recovery could be determined based on sampling over time.

Alternative FPS-3 includes capping which would be effective in the long term. The cap would require LTM, land use restrictions to limit future disturbance of the cover soil, and inspections/ maintenance for erosion controls and revegetated areas. Inspections and maintenance would include inspecting existing bank erosion controls in the Plainwell TCRA areas.

Alternative FPS-4A includes removal of contaminated floodplain soil exceeding a RAL of 20 mg/kg. This would be effective in protecting receptors from exposure to surface soil in the long term. The excavated area would require ICs to limit disturbance of the backfill/cover soil. Inspections/maintenance of the erosion controls and revegetated areas also would be required.

Alternative FPS-4B would remove PCBs from all areas of the floodplains exceeding a RAL of 0.5 mg/kg, providing long-term effectiveness and permanence in terms of exposure to site contaminants. However, this would come at the cost of extensive habitat destruction.

Reduction of Toxicity, Mobility, or Volume through Treatment

None of the floodplain soil alternatives employ treatment technologies to reduce the toxicity, mobility or volume of the contaminated materials. However, Alternative FPS-3 would cap contaminated soils and Alternatives FPS-4A and FPS-4B would remove significant volumes of contaminated soil within Area 1, thereby reducing the ability of the PCB-contaminated soil to be mobilized into the river in the future. Due to the nature of the contamination, the PCB-contaminated soils do not lend themselves to cost-effective treatment.

Short-term Effectiveness

Alternatives FPS-1 and FPS-2 would not have any adverse short-term impacts, as no active construction work is associated with these alternatives. However, no mitigative measures would be in place to reduce exposures to human and ecological receptors until such time as protective levels might be achieved, rendering these alternatives not effective in the short term. The length of time it would take to meet PRGs and RAOs is difficult to estimate, as data regarding depositional rates in the floodplain are not currently available, but could be prolonged.

Alternatives FPS-3 and FPS-4A would be effective in the short term, as the exposure risk would be eliminated immediately upon cap completion (FPS-3) and upon removal of soils and backfilling of the excavation areas (FPS-4A). Moderate damage to habitat over the 7 acres of capped and/or excavated soil and the required support areas (roads, staging areas) would be addressed by revegetating the disturbed areas to initiate habitat recovery. Risk to workers would be managed through safe work practices and training. Potential impacts to the public during implementation of the cleanup work, including disruptions and intrusions to neighboring residents, equipment and truck traffic, and material handling and staging operations, would be managed by monitoring in active work areas, safe work practices, and training. The implementation period for Alternatives FPS-3 and FPS-4A would be approximately 1 year.

The extensive excavation work required by Alternative FPS-4B would have the greatest degree of short-term impacts because of the long construction period (more than 10 years) and extensive habitat destruction throughout Area 1, rendering this alternative not effective in the short term. Potential impacts to the public during implementation of the cleanup work would include the same sort of issues discussed above for FPS-3 and FPS-4A, but such impacts would continue for more than 10 years.

Implementability

Alternatives FPS-1 and FPS-2 could be easily implemented. No active measures are associated with Alternative FPS-1, and Alternative FPS-2 would include only LTM, inspections and maintenance of existing ECs for erosion control.

Alternatives FPS-3 and FPS-4A are relatively straightforward and implementable. Access roads and staging areas would need to be constructed to implement work; some support areas previously used for TCRA implementation may be available for reuse. Property access and

permits/waivers would be needed to work in the floodplain. Conventional earthmoving equipment for capping or excavation work is readily available. For removal activities conducted under FPS-4A, dewatering and water management systems are readily available and would be similar to those used during TCRA implementation. Revegetation and erosion controls would be implemented using experience gained from the previous TCRAs.

For Alternative FPS-4B, the area of impact would be excessive. Conventional equipment for excavation, dewatering, and transportation of soils is readily available. However, obtaining access agreements for such a large-scale cleanup area, including private residential and commercial properties along approximately 17 miles of river, would be very difficult and potentially impossible, even with compensation. Obtaining an approval/waiver for this level of wetland/riparian habitat destruction would be unlikely.

Cost

The estimated costs for each alternative have an expected accuracy of +50% to -30%. Costs for the floodplain soil alternatives range from zero to $486 million, as listed below:

Alternative FPS-1	$0
Alternative FPS-2	$1,300,000
Alternative FPS-3	$3,800,000
Alternative FPS-4A	$6,800,000
Alternative FPS-4B	$486,000,000

Alternative FPS-4B is the most costly alternative because 1.4 million cubic yards of soil would be removed throughout Area 1 and transported for offsite disposal. The costs for Alternatives FPS-2, FPS-3, and FPS-4A are two orders of magnitude lower than the cost for Alternative FPS-4B. Other than the "no action" alternative, Alternative FPS-2 is the least costly alternative because the only remedy components that have associated costs are LTM, inspections, and the maintenance of existing ECs.

The final cost estimate for the selected floodplain soil remedy will be developed and refined during the RD.

State Agency Acceptance

The State of Michigan's acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for Area 1 of OU5.

Community Acceptance

The local community's acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for Area 1 of OU5.

9. EPA's PREFERRED ALTERNATIVE

This section describes EPA's preferred sediment alternative and floodplain soil alternative and explains the rationale for those preferences. As noted earlier in this Proposed Plan, EPA has not identified any principal threat wastes at OU5 that need to be addressed.

EPA's Preferred Sediment Alternative – Alternative S-3A: Removal of Hot Spot Areas and Crown Vantage Side Channel, MNR, ICs, and ECs

Based on the evaluation of alternatives summarized in the "Evaluation of Alternatives" section above, EPA believes that Sediment Alternative S-3A is the most appropriate sediment cleanup alternative for Area 1 of OU5. The preferred sediment alternative consists of the following main components:

1. Alternative S-3A includes the removal of impacted sediment in at least five hot spot areas and the Crown Vantage side channel, with MNR, ICs and ECs throughout Area 1. The five identified hot spots (KPT-19, KPT-20, KRT-4, KRT-5/FF-19, and S-IM1) are located within the stretch of Area 1 known as the Remedial Reach (spanning from RM69.3 to RM72.3). The Remedial Reach includes Section 3 and the adjacent portions of Sections 2 and 4 (see Figure 5).

2. Additional sampling throughout the Remedial Reach would be performed during RD to further delineate the removal boundaries around the known hot spots and to identify other locations for remediation within the Remedial Reach. Sampling would be conducted in accordance with an EPA-approved work plan. The mass of PCBs that would be removed from the river through this alternative is estimated to be approximately 390 kg.

3. Additional sampling would occur in Section 8 of Area 1 to document post-TCRA conditions.

4. LTM and ICs/ECs would be implemented until PRGs are achieved. The LTM program would confirm the ongoing effects of natural processes and document the continued declines in PCB concentrations in various media, resulting in reductions in risk and ecological exposures. It is anticipated that the monitoring program would be designed to supplement the current program that includes fish and water column monitoring. The final components of the LTM program would be defined during RD.

5. The anticipated average removal depth in the identified hot spots ranges from 24 to 40 inches, based on current data from the Remedial Reach. The estimated total volume that would be removed is approximately 19,500 cy. It is assumed that residuals management in the form of a thin-layer cap addition would occur in approximately 50% of the area; the need for and effectiveness of a thin-layer cap would be evaluated during RD.

6. Typical silt curtain controls and surface water monitoring would be employed for turbidity and PCB migration from removal areas. Restoration would be conducted where disturbances to the existing vegetation and natural habitats would occur within upland,

wetland, and riverbank areas due to the construction of support facilities and implementation of remedial activities. Excavated channel edges would be stabilized, and formerly vegetated upland areas that are disturbed for river access would be restored in kind with topsoil and revegetated with native seed mixes and woody plantings.

7. Removal of PCB-containing sediment would also serve to remove other constituents detected in Area 1 sediment, including organic constituents and metals. Removal, along with an assumed thin-layer cap addition for management of residuals, would provide protection to ecological receptors from exposure to PCBs as well as these other constituents. The collocation of non-PCB constituents with PCBs in the sediment does not imply that they came from a similar source area or that they are related to paper mill recycling processes. Rather, their collocation is likely a result of shared fate and transport mechanisms.

8. Calculations show that the SWAC for the Remedial Reach would be reduced from 1.76 mg/kg to 1.09 mg/kg following the remedial action construction work. This alternative would then rely on natural recover processes to achieve the PRGs and RAOs over time.

9. This alternative would reach PRGs for smallmouth bass within 32 years after ROD issuance. The time to complete construction would be approximately 1 to 2 years, at an estimated cost of $13,100,000 to $16,600,000 (depending on the number of hot spot areas to be remediated).

10. Site-specific fish consumption advisories established and publicized by the State of Michigan would continue to manage risks posed to anglers and their families from consumption of PCB-containing fish. These advisories are already in place for Area 1, and the advisory for each fish type would remain in effect until fish tissue PCB concentrations achieve RAOs for the fish specified. The advisories would be reviewed and verified annually as a component of the site ICs.

EPA's Preferred Floodplain Soil Alternative – Alternative FPS-4A: Removal (RAL 20), ICs, and ECs

Based on the evaluation of alternatives summarized in the "Evaluation of Alternatives" section above, EPA believes that Floodplain Soil Alternative FPS-4A is the most appropriate soil cleanup alternative for Area 1 of OU5. The preferred floodplain soil alternative consists of the following main components:

1. Alternative FPS-4A includes the excavation of 11,300 cy of floodplain soil in the former Plainwell Impoundment with PCB concentrations greater than an RAL of 20 mg/kg in contiguous areas of one-quarter acre or larger, and the placement of clean backfill/topsoil in excavated areas to restore floodplain grade elevations. The total excavation footprint would be approximately 7 acres (see Figure 6).

2. The actual excavation areas/footprints would be determined during RD based on additional floodplain soil sampling. Soil sampling in Area 1 for PCBs in the floodplain

outside of the former Plainwell Impoundment TCRA study area would also be performed prior to or during RD.

3. Excavation would be completed to a target standard depth of 12 inches to remove contaminated soil in the ecological exposure zone (i.e., the top 6 inches), plus a 6-inch buffer. A geotextile fabric would be placed over the completed excavation area. Backfill would include 6 inches of fill soil and a minimum 6-inch topsoil cover to support revegetation and restoration of ecological habitat.

4. Alternative FPS-4A includes ICs, ECs, and LTM. ECs would be implemented to ensure the floodplain material does not erode into the river. LTM would be required to evaluate backfill erosion, vegetative cover, and ECs over time. Periodic maintenance would be carried out as necessary to repair or maintain the integrity of these systems. ICs (land use restrictions) also would be implemented to protect/restrict future land use changes.

5. This alternative would result in 98% to 100% of home ranges for ecological receptors being below the floodplain soil PRG of 11 mg/kg following completion of the remedial action construction work. The time to complete construction would be approximately 1 year, at an estimated cost of $6,800,000.

6. Additional sampling would be conducted to determine whether any of the natural floodplain areas within Area 1 exceed the residential PRG. Areas exceeding the PRG would be remediated as described above.

Summary of Rationale for the Preferred Alternative

Sediment Alternative

EPA believes that Sediment Alternative S-3A provides the best balance of the evaluation criteria among all the sediment alternatives. Alternative S-3A would be protective of human health and the environment, would meet all federal and state ARARs, would achieve the RAOs for this proposed remedial action, would be straightforward in its implementation, and would be effective in the long term and permanent.

Alternative S-3A would provide long-term and permanent protection against exposure to contaminated materials by excavating approximately 19,500 cubic yards of PCB-contaminated sediment from at least five hot spot areas and the Crown Vantage side channel, and then relying on natural recovery processes, in conjunction with ICs and ECs, to achieve the PRGs and RAOs over time. Alternative S-3A would be effective in the short term, as it would result in immediate reductions in sediment SWACs while posing easily manageable risks to workers and the local community during implementation. Alternative S-3A would be administratively and technically implementable and could be completed within 2 years.

Alternative S-3A is cost-effective because it would significantly reduce SWACs in the Remedial Reach through source removal with minimal habitat destruction, would achieve PRGs for smallmouth bass within 32 years (only 7 years longer than Alternatives S-4A and S-4B), and

would require no long-term maintenance of capped material (as in Alternative S-3B), at less than half the cost of Alternatives S-4A and S-4B.

Alternative S-3A does not reduce the toxicity, mobility or volume of the contamination through treatment because the relatively low-level PCB contamination that is present does not lend itself to any cost-effective treatment.

Floodplain Soil Alternative

EPA believes that Floodplain Soil Alternative FPS-4A provides the best balance of the evaluation criteria among all the floodplain soil alternatives. Alternative FPS-4A would be protective of human health and the environment, would meet all federal and state ARARs, would achieve the RAOs for this proposed remedial action, would be straightforward in its implementation, and would be effective in the long term and permanent.

Alternative FPS-4A would provide long-term and permanent protection against exposure to contaminated soils by excavating approximately 7 acres of floodplain soil exceeding the RAL of 20 mg/kg in the Plainwell Impoundment, resulting in 98% to 100% of home ranges for ecological receptors being protected. Alternative FPS-4A would be effective in the short term, as the exposure risk would be eliminated immediately upon soil removal and backfilling of the excavation areas while posing easily manageable risks to workers and the local community during implementation. Alternative FPS-4A would be administratively and technically implementable and could be completed within 1 year.

Although Alternative FPS-4A costs more than Alternative FPS-3, Alternative FPS-4A is cost effective because it would achieve PRGs immediately upon completion of the construction work with limited habitat destruction, and would remove the contaminated soil instead of capping it (as in Alternative FPS-3), resulting in a greater degree of long-term effectiveness and permanence. In addition, it would not reduce floodplain storage due to adding cap material or require long-term maintenance of a cap (as in Alternative FPS-3).

Alternative FPS-4A does not reduce the toxicity, mobility or volume of the contamination through treatment because the relatively low-level PCB contamination that is present does not lend itself to any cost-effective treatment.

Summary

Based on the information currently available, EPA believes the preferred alternatives identified above meet the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. EPA expects the preferred alternatives to satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs (or justify a waiver); (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element, or explain why the preference for treatment will not be met.

There have already been two site-wide five-year reviews completed. Since it will be several years before fish tissue concentrations attain PRGs, and since PCBs in both the Plainwell and Plainwell 2 floodplain soils will remain above levels that allow for unlimited use and unrestricted exposure (i.e. residential use), Area 1 of OU5 will be included in future site-wide five-year reviews.

Next Steps

EPA, in consultation with MDEQ, will evaluate public reaction to the preferred cleanup alternatives during the public comment period before selecting a final sediment alternative and floodplain soil alternative as the Area 1 OU5 remedy. Based on new information or public comments, EPA may modify its preferred alternative or choose another, so EPA encourages the public to review and comment on all of the cleanup alternatives.

EPA will respond in writing to all significant comments in a Responsiveness Summary which will be part of the ROD. EPA will announce the selected cleanup alternatives in local newspaper advertisements and will place a copy of the ROD in the local information repositories and on EPA's website at http://www.epa.gov/region5/cleanup/kalproject/.

Figure 1: Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

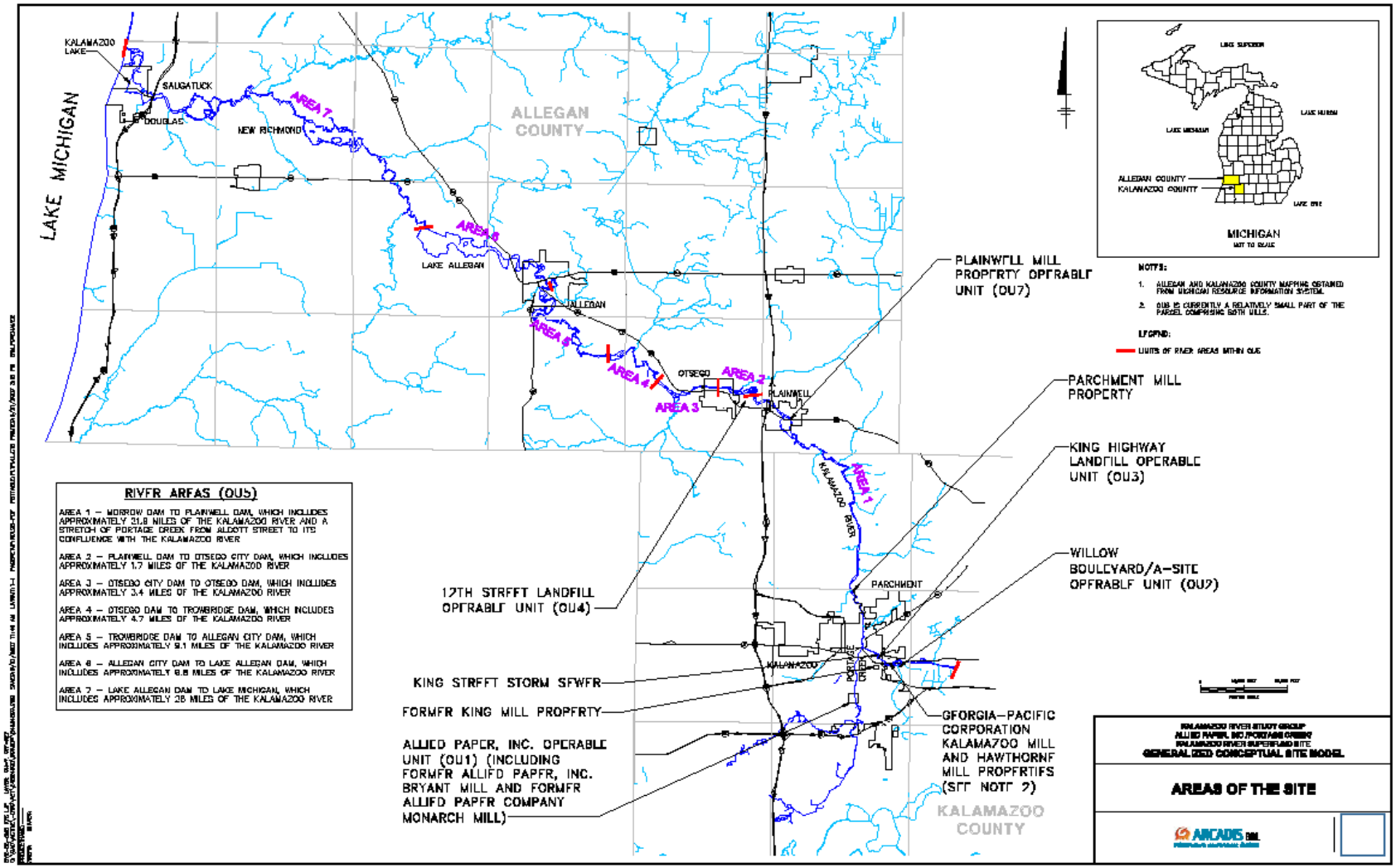

Figure 2: Operable Unit 5

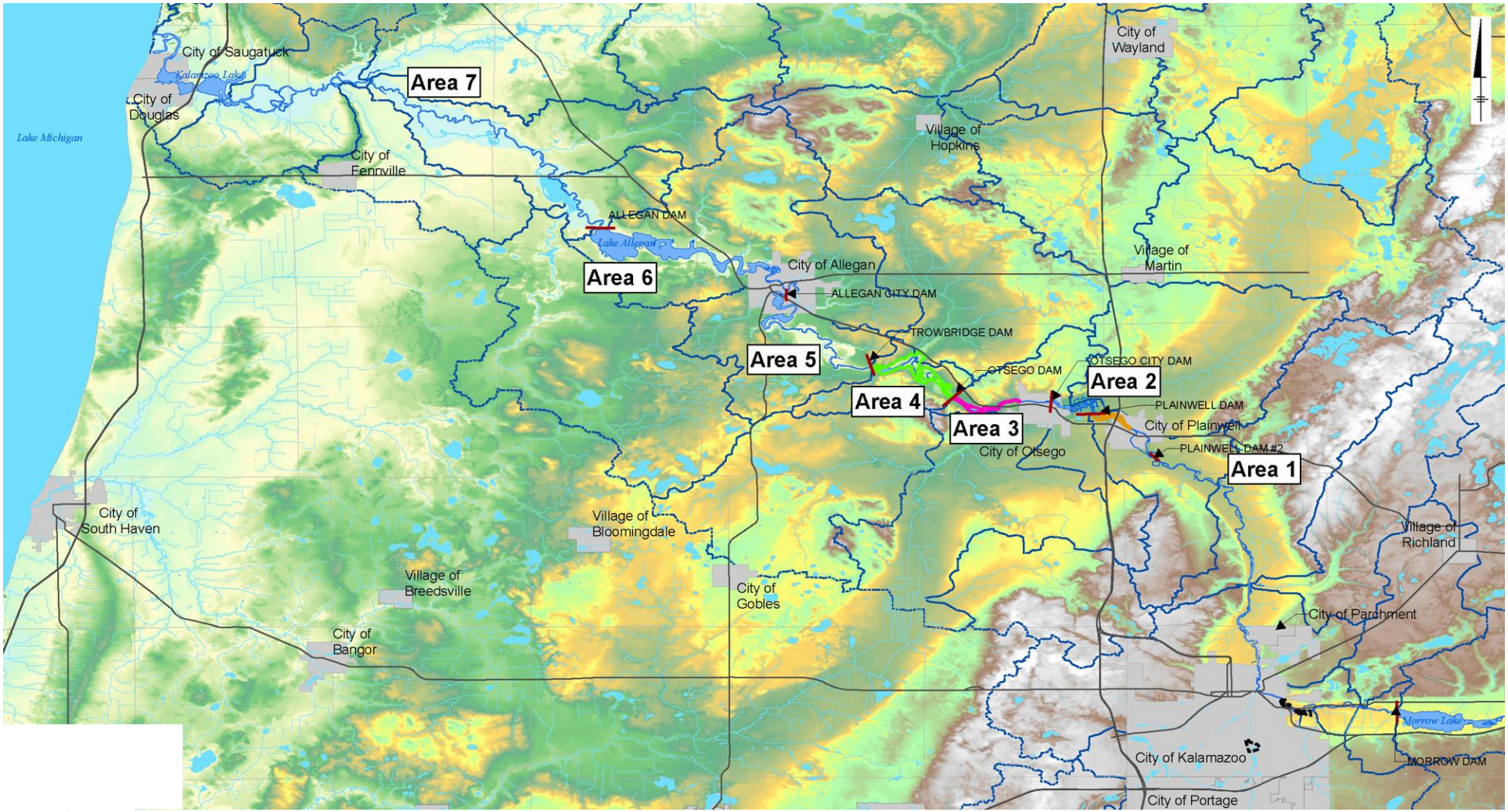

Figure 3: Area 1

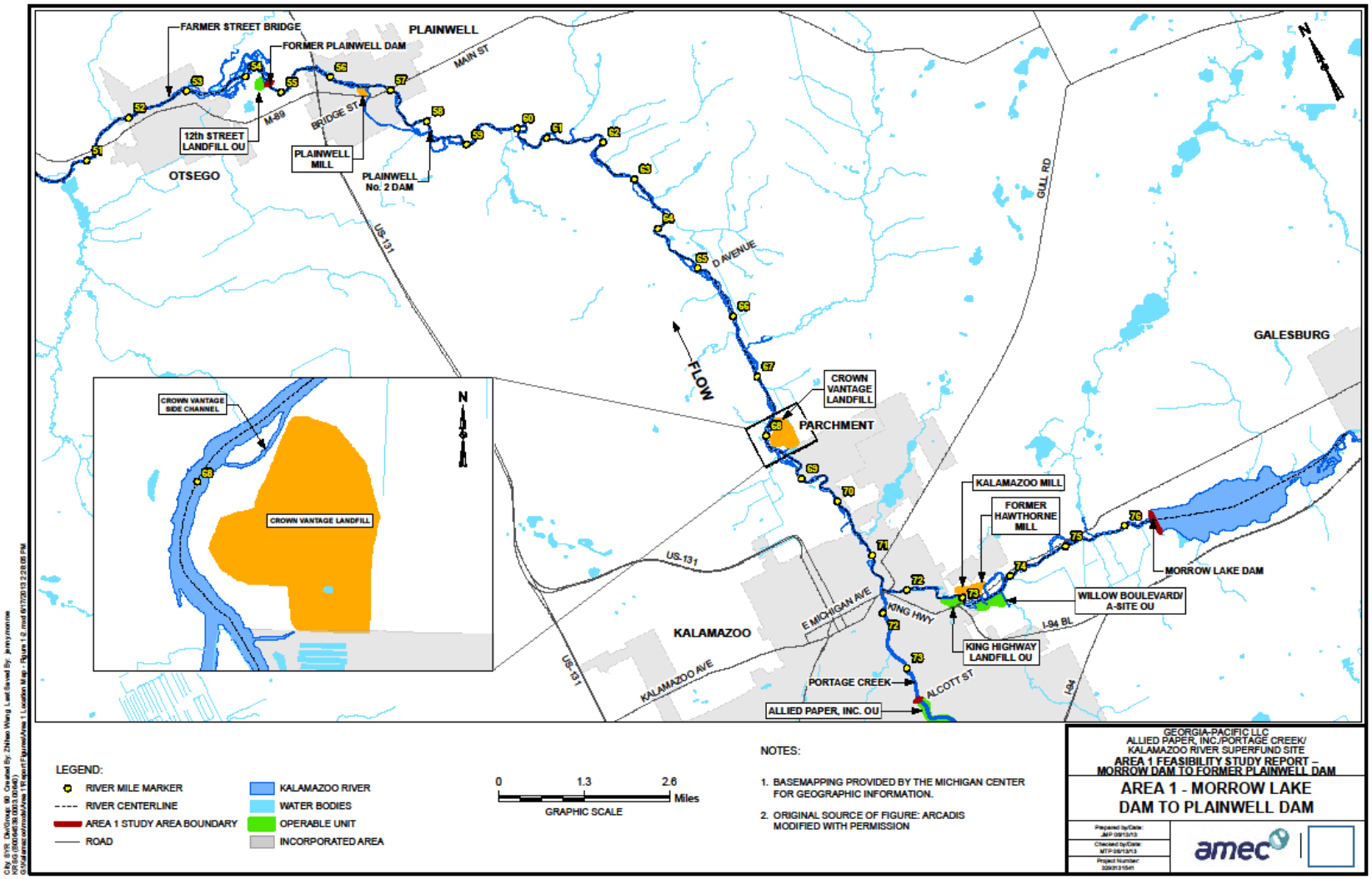

Figure 4: Eight Sections of Area 1

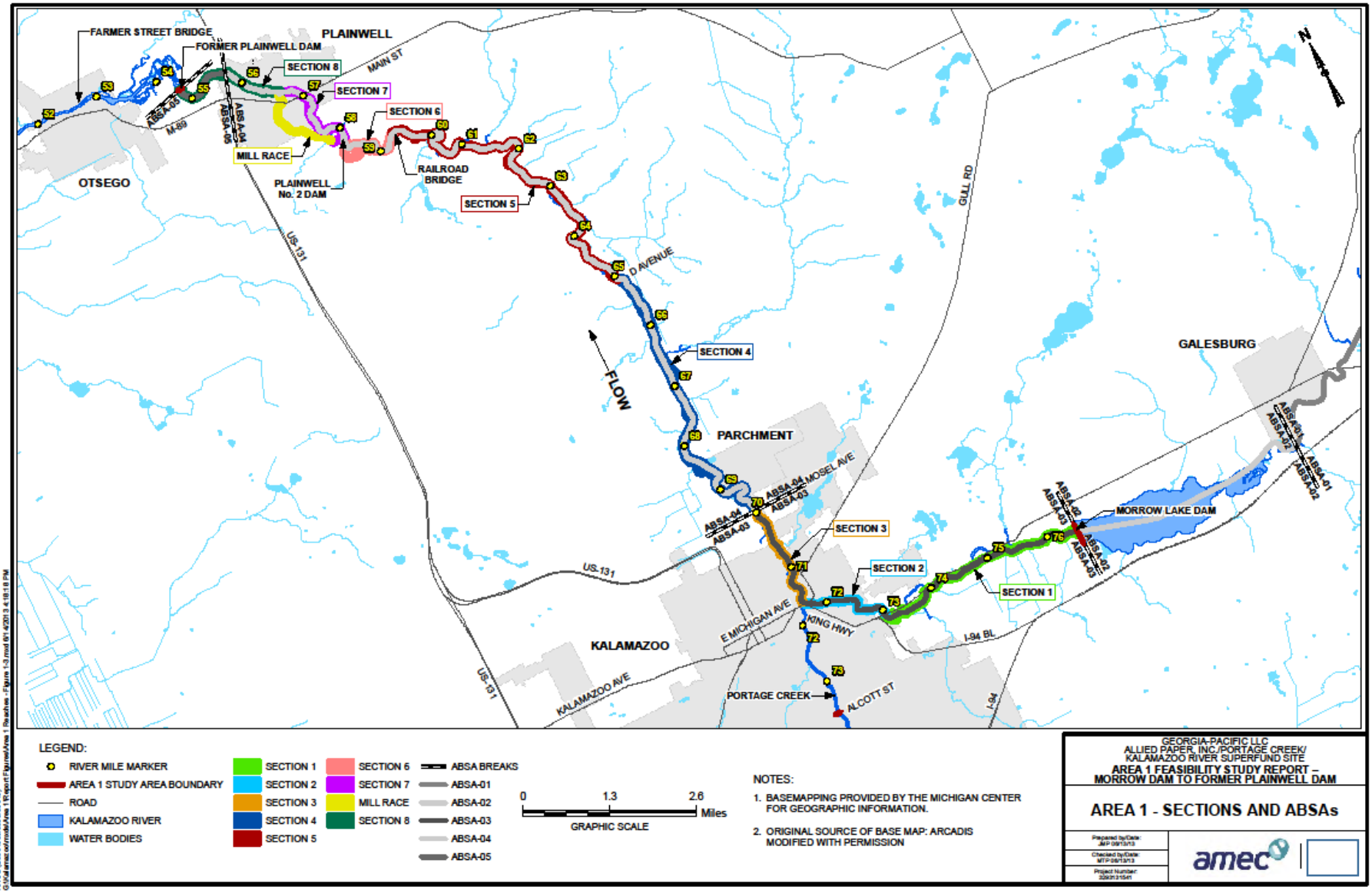

Figure 5: Remedial Reach

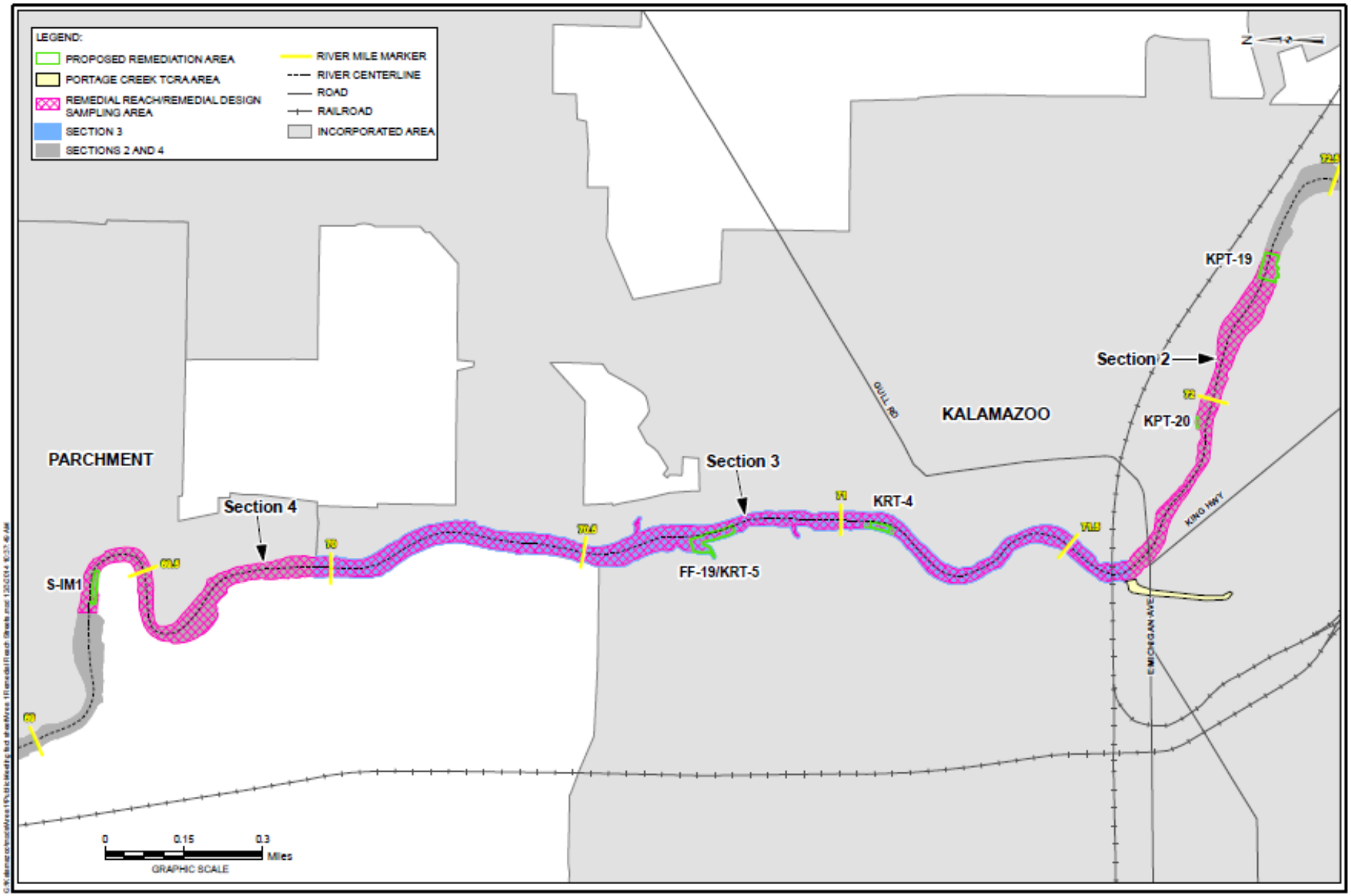

Figure 6: Plainwell Impoundment Floodplain Soil Excavation Areas

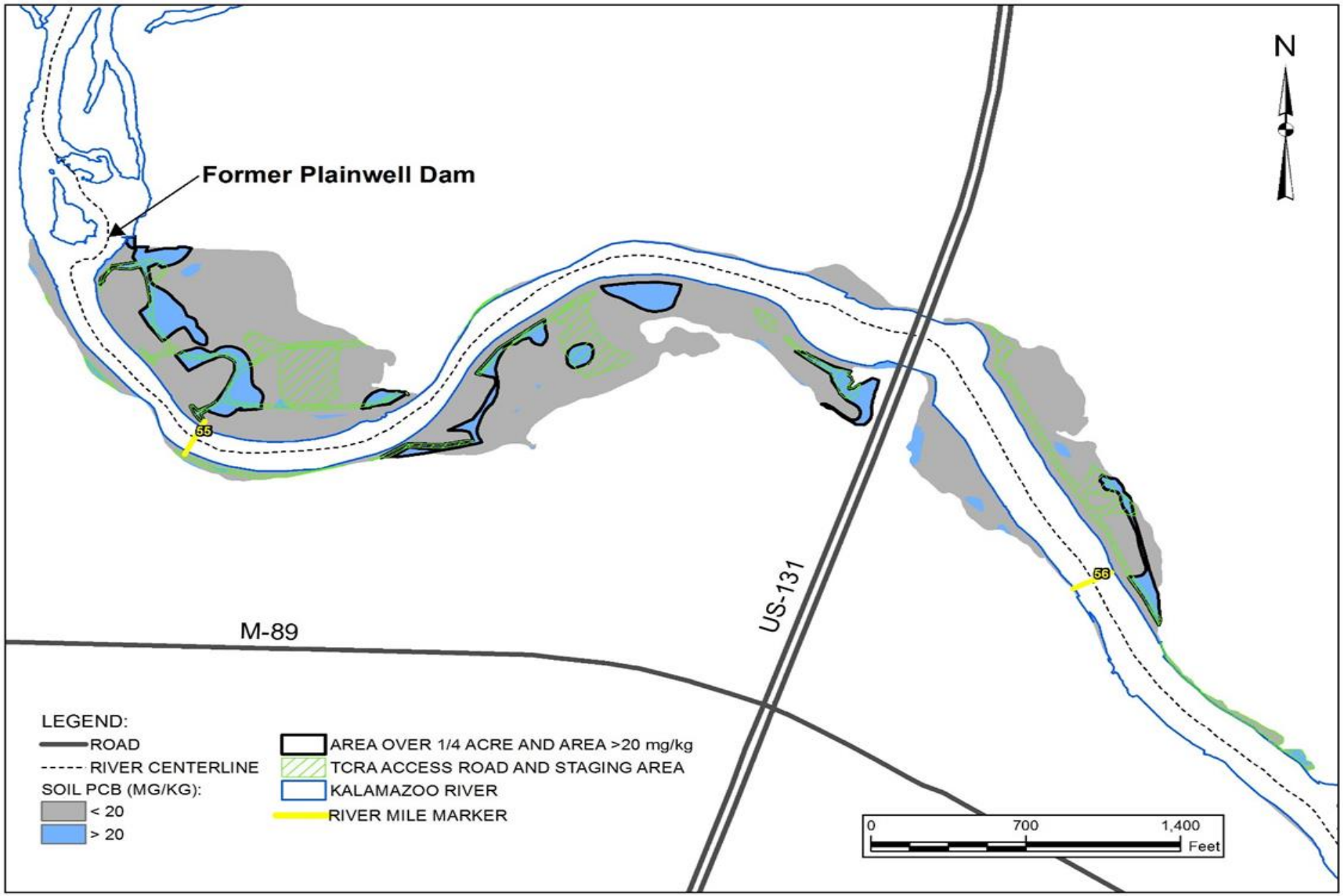

Table 1: SWACs by Section for Area 1

SWAC Calculations By Section and Bounds on Confidence Limits
Area 1, OU-5 Kalamazoo River

Section	Interval	SWAC	Number of Data Points	Chebyshev Area-weighted (5% LCL, 95% UCL) CI Bounds **	
Section 1	0-6"	0.11	90	<DL	0.28
Section 2	0-6"	0.23	42	0.14	0.33
Section 3	0-6"	2.19	33	<DL	5.59
Section 4	0-6"	0.42	92	<DL	1.16
Section 5	0-6"	0.24	64	0.07	0.42
Section 6	0-6"	0.72	43	<DL	1.91
Section 7	0-6"	0.72	13	<DL	1.76
Mill Race	0-6"	0.33	17	<DL	0.91
Section 8	0-6"	1.77	29	<DL	5.74
Section 1	6-12"	0.06	87	0.01	0.12
Section 2	6-12"	0.22	40	0.10	0.34
Section 3	6-12"	4.25	32	<DL	10.11
Section 4	6-12"	0.24	83	<DL	0.48
Section 5	6-12"	0.11	58	<DL	0.23
Section 6	6-12"	0.31	34	0.04	0.58
Section 7	6-12"	0.66	11	<DL	2.40
Mill Race	6-12"	0.21	12	<DL	0.56
Section 8	6-12"	1.79	22	<DL	5.28
Section 1	12-24"	0.12	66	<DL	0.35
Section 2	12-24"	1.05	26	<DL	5.16
Section 3	12-24"	18.13	26	<DL	42.67
Section 4	12-24"	0.26	49	<DL	0.78
Section 5	12-24"	0.09	29	<DL	0.27
Section 6	12-24"	0.39	26	<DL	0.98
Section 7	12-24"	0.76	8	<DL	2.29
Mill Race	12-24"	0.07	11	<DL	0.17
Section 8	12-24"	2.97	14	<DL	9.09

Notes: <DL means less than detection limit.
Depths greater than six inches actually represent depth, area-weighted average concentrations.

Table 2: Post-TCRA PCB Concentrations by Floodplain Soil Area

Soil Areas	Mean PCB Concentration (mg/kg)		Maximum PCB Concentration (mg/kg)	
	Surface	Subsurface	Surface	Subsurface
Soil Area 1	0.76	0.30	5.8	5.9
Soil Area 2	2.1	0.48	15	14
Soil Area 3	1.6	2.0	8.4	18
Soil Area 4	8.5	1.9	49	79

Table 3: Sediment Alternatives

Alternative	Capping Area (acres) / Removal Volume (cy)	Years to Reach PRGs for Smallmouth Bass	Overall Protection of Human Health and the Environment	Compliance with ARARs	Short-term Effectiveness	Long-term Effectiveness	Reduction of Toxicity, Mobility, and Volume Through Treatment	Implementability	Total Cost
S-1	None	87	Undocumented	Undocumented	Not Effective	Effective	No treatment, No reduction	Nothing to implement	$0
S-2	None	87	Protective, lengthy timeframe	Complies	Not Effective	Effective	No treatment, No reduction	Readily implementable	$2,700,000
S-3A	0 / 19,500	32	Protective, reasonable timeframe	Complies	Effective	Effective	No treatment, Reduced volume	Readily implementable	$13,100,000 to $16,600,000
S-3B	1.2 / 15,600	32	Protective, reasonable timeframe	Complies	Effective	Effective	No treatment, Reduced mobility and volume	Readily implementable	$12,200,000 to $15,700,000
S-4A	0 / 63,900	25	Protective, reasonable timeframe	Complies	Effective	Effective	No treatment, Reduced volume	Readily implementable	$33,700,000 to $37,200,000
S-4B	1.2 / 59,900	25	Protective, reasonable timeframe	Complies	Effective	Effective	No treatment, Reduced mobility and volume	Readily implementable	$32,300,000 to $35,800,000
S-5	0 / 300,000 to 490,000	45	Protective, longer timeframe, extensive habitat destruction	Compliance delayed	Not Effective	Effective	No treatment, Reduced volume	Requires extensive effort	$202,000,000 to $337,000,000

Table 4: Floodplain Soil Alternatives

Alternative	Capping or Excavation Footprint	Remediation Time	Overall Protection of Human Health and the Environment	Compliance with ARARs	Short-term Effectiveness	Long-term Effectiveness	Reduction of Toxicity, Mobility, and Volume Through Treatment	Implementability	Total Cost
FPS-1	None	Lengthy	Undocumented	Unable to predict	Not Effective	Unknown, indeterminable	No treatment, No reduction	Nothing to implement	$0
FPS-2	None	Lengthy	Protective, lengthy timeframe	Unable to predict	Not Effective	Unknown, determinable	No treatment, No reduction	Readily Implementable	$1,300,000
FPS-3	7 Acres	1 year	Protective	Complies	Effective	Effective	No treatment, Reduced mobility	Readily Implementable	$3,800,000
FPS-4A	7 Acres	1 year	Protective	Complies	Effective	Effective	No treatment, Reduced mobility & volume	Readily Implementable	$6,800,000
FPS-4B	850 Acres	10 years	Protective	Complies	Effective	Effective	No treatment, Reduced volume	Difficult with access limitations and extensive habitat destruction	$486,000,000